33rd Scientific Conference 2016

OILSEED CROPS – ADVANCES IN GENETICS, BREEDING, TECHNOLOGY AND ANALYTICS OF LIPIDS

Abstracts

Poznań University of Life Sciences

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32rd Scientific Conference

OILSEED CROPS – ADVANCES IN GENETICS, BREEDING, TECHNOLOGY AND ANALYTICS OF LIPIDS

organised by:

Plant Breeding and Acclimatization Institute – National Research Institute (IHAR-PIB)
Research Division in Poznan

and

Department of Food Chemistry and Instrumental Analysis
Institute of Food Technology
University of Life Sciences in Poznan

Abstracts

5–6.04.2016 Poznań

Venue: Congress Centre Hotel IOR Poznan, W.Wegorka 20a

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Opracowanie redakcyjne i skład komputerowy — MarJan

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Programme Conference

5.04.2016

10^{00}–10^{30} OPENING CEREMONY

prof. dr. hab. IWONA BARTKOWIAK-BRODA – Kierownik Oddziału IHAR – PIB w Poznaniu

prof. dr. hab. EDWARD ARSENIUK — Dyrektor IHAR – PIB

prof. dr hab. JAN PIKUL — Prorektor Uniwersytetu Przyrodniczego w Poznaniu

10^{30}–13^{00} PLENARY SESSION

Chairmen: prof. dr. hab. EDWARD ARSENIUK i prof. dr hab. JAN PIKUL

10^{30}–11^{00} Christian Obermeier

Justus Liebig University, Giessen, Niemcy

Structural genome rearrangements associated with resistance and quality traits in oilseed rape

11^{00}–11^{30} Ryszard Amarowicz

Institute of Animal Reproduction and Food Research of Polish Academy of Sciences

Flaxseed lignans: methods of their determination, biological and antioxidant activity

11^{30}–12^{00} Marcus Jansen

LemnaTec, Aachen, Niemcy

Phenotyping – characterising plant properties at multiple scales

12^{00}–12^{20} Krzysztof Pudełko

Wielkopolska Centre of Advanced Technologies in Poznan

Poznan University of Life Sciences, Department of Biochemistry and Biotechnology

Research potential of Wielkopolska Centre of Advanced Technologies

12^{20}–12^{40} Aleksander Siger[1], Krzysztof Dwiecki[1], Wojciech Borzyszkowski[2], Mieczysław Turski[2], Magdalena Rudzińska[3], Małgorzata Nogala-Kałucka[1]

[1] Poznan University of Life Sciences, Faculty of Food Science and Nutrition, Department of Biochemistry and Food Analysis

[2] Poznan University of Life Sciences, Faculty of Forestry, Department of Forest Management

[3] Poznan University of Life Sciences, Faculty of Food Science and Nutrition, Institute of Food Technology of Plant Origin

Beech oil – the forgotten source of bioactive compounds

12^{40}–13^{00} Katarzyna Mikołajczyk[1], Mirosława Dabert[2], Wojciech M. Karłowski[2], Jan Bocianowski[3], Joanna Nowakowska[1], Stanisław Spasibionek[1], Wiesława Popławska[1], Alina Liersch[1], Teresa Cegielska-Taras[1], Iwona Bartkowiak-Broda[1]

[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan

[2] Adam Mickiewicz University in Poznan, Faculty of Biology

[3] Poznan University of Life Sciences

Molecular assays in winter oilseed rape breeding programs at the IHAR – PIB, Poznan Division

13^{00}–14^{00} LUNCH AND POSTER SESSION

14^{00}–15^{40} PLENARY SESSION
Chairmen:
prof. dr hab. RYSZARD AMAROWICZ, prof. dr hab. WOJCIECH BUDZYŃSKI

14^{00}–14^{20} Katarzyna Gacek[1], Krzysztof Michalski[1], Iwona Bartkowiak-Broda[1], Jan Bocianowski[2], Philipp E. Bayer[3], David Edwards[3], Jacqueline Batley[3]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] Poznan University of Life Sciences
[3] School of Plant Biology, University of Western Australia, Perth
Genome-wide association study of genetic control of fatty acid composition in oilseed rape (*Brassica napus* L.) seeds

14^{20}–14^{40} Andrzej Wojciechowski[1], Janetta Niemann[1], Iwona Bartkowiak-Broda[2], Teresa Piętka[2], Kamil Kolan[1], Adrian Niemczyk[1]
[1] Poznan University of Life Sciences, Department of Genetics and Plant Breeding
[2] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Assessement of self-incompatibility and cross compatibility of chosen cultivars and accessions of four mustard species (*Brassicaceae*) on the basis of pollen tube observations and set seeds

14^{40}–15^{00} Jerzy Nawracała, Danuta Kurasiak-Popowska, Tadeusz Łuczkiewicz
Poznan University of Life Sciences, Department of Genetics and Plant Breeding
Possibility of breeding and cultivation of fals flax (*Camelina sativa* (L.) Crantz) in Poland

15^{00}–15^{20} Aleksander Siger[1], Malgorzata Nogala-Kałucka[1], Laurencja Szała[2], Teresa Cegielska-Taras[2]
[1] Poznan University of Life Sciences, Faculty of Food Science and Nutrition, Department of Biochemistry and Food Analysis
[2] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Studies on the variability of antioxidant lipophilic and hydrophilic compounds content in the seeds of new breeding rapeseed lines

15^{20}–15^{40} Marianna Raczyk, Magdalena Rudzińska, Dominik Kmiecik
Uniwersytet Przyrodniczy w Poznaniu
Products formed during thermo-oxidative degradation of phytosteryl esters

15^{40}–16^{20} POSTER SESSION AND COFFEE BREAK

16^{20}–18^{00} PLENARY SESSION
Chairmen:
prof. dr hab. EDWARD GACEK i prof. dr hab. MAŁGORZATA NOGALA-KAŁUCKA

16^{20}–16^{40} Ewa Myśliwiec
Polish Association of Oil Producers
Promotion of rapeseed oil and its perception by consumers – chances and dangers

16^{40}–17^{00} Ripaud Simon — Syngenta Polska Sp. z o.o.
Current trends in breeding and rapeseed protection

17^{00}–17^{20} Edyta Popis, Katarzyna Ratusz, Zuzanna Bajorek, Krzysztof Krygier
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
Evaluating the quality of market linseed oils

17^{20}–17^{40} Katarzyna Ratusz, Edyta Popis, Małgorzata Wroniak
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
The quality and safety of *Camelina sativa* oils

17^{40}–18^{00} Ewa Ostrowska-Ligęza[1], Magdalena Wirkowska-Wojdyła[1], Agata Górska[1], Joanna Bryś[1], Ada Rejch[1], Maltam Shamilowa[2]
[1] Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Department of Chemistry
[2] Baku State University, Faculty Ecology and Soil Science, Department of Ecological Chemistry
Thermokinetic analysis of cocoa butter by differential scanning calorimetry

19^{00} SOCIAL EVENT — RUNGE COLLEGIUM, UNIVERSITY OF LIFE SCIENCES IN POZNAŃ

6.04.2016

9^{00} – 11^{10} PLENARY SESSION
Chairmen:
prof. dr hab. TERESA CEGIELSKA-TARAS i dr hab. MAGDALENA RUDZIŃSKA

9^{00}–9^{30} Henryk Jeleń, Anna Gracka, Małgorzata Majcher
Poznan University of Life Sciences, Faculty of Food Science and Nutrition
Flavoromics in the evaluation of oils quality

9^{30}–10^{00} Marek Mrówczyński, Marek Korbas, Henryk Wachowiak, Jakub Danielewicz
Institute of Plant Protection – NRI in Poznan
Ecological and economic aspects of possible withdrawal of selected active ingredients from crop protection products in winter rapeseed cultivation technology

10^{00}–10^{20} Marek Seidenglanz[1], Jana Poslušná[1], Pavel Kolařík[2], Jiří Rotrekl[2], Eva Hrudová[3], Pavel Tóth[3], Jiří Havel[4], Eva Plachká[4], Ján Táncik[5], Kamil Hudec[5]
[1] Agritec Plant Research Ltd., Department of Plant Protection, Šumperk, Czech Republic
[2] Agriculture Research Ltd, Troubsko, Czech Republic
[3] Mendel University in Brno, Czech Republic
[4] OSEVA Development and Research Ltd., Workplace at Opava, Czech Republic
[5] Slovak University of Agriculture in Nitra, Slovakia
Development of pyrethroid resistance in Czech and Slovak *Meligethes* populations (2009–2015) and correlations between their susceptibilities to lambda-cyhalothrin and chlorpyrifos-ethyl resp. thiacloprid

10^{20}–10^{50} Veronika Řičařová[1], Jan Kazda[1], Petr Baranyk[2], Josef Škeřík[2], Stephen Strelkov[3], Pavel Ryšánek[1]
[1] Department of Plant Protection, Czech University of Life Sciences Prague
[2] Union of Oilseed Growers and Processors
[3] Food and Nutritional Science, University of Alberta, Canada
Studies of clubroot (*Plasmodiophora brassicae* Wor.) on oilseed rape in the Czech Republic

10^{50}–11^{10} Michał Starzycki[1], Elżbieta Starzycka-Korbas[1], Jacek Żebrowski[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] University of Rzeszow
Investigation of metabolome *Brassica napus L. mutants* after primary infection by phytoplasmas like organism

11^{10}–11^{50} **POSTER SESSION AND COFFEE BREAK**

11^{50}–13^{30} PLENARY SESSION
Chairmen: prof. dr hab. JAN KRZYMAŃSKI, prof. dr hab. MAREK KORBAS

11^{50}–12^{10} Anna Gracka[1], Eliška Kludská[2], Jaromír Hradecký[2], Marie Bicová[2], Jana Hajšlová[2], Henryk Jeleń[1]
[1] Poznan University of Life Sciences, Faculty of Food Science and Nutrition
[2] University of Chemistry and Technology, Prague, Czech Republic
The influence of storage on the volatile profile composition of cold pressed oils obtained from gold and brown seeds using GCxGC and GC-HRT

12^{10}–12^{30} Maria Sielicka, Maria Małecka
Poznan University of Economics and Business, Department of Food Commodity Science
Oilseed cakes as source of antioxidants

12^{30}–12^{50} Dorota Klensporf-Pawlik, Marianna Gabryelczyk
Poznan University of Economics and Business, Department of Food Commodity Science
The quality of exotic cold pressed oils

12^{50}–13^{10} Joanna Bryś, Magdalena Wirkowska-Wojdyła, Agata Górska, Ewa Ostrowska-Ligęza, Magdalena Burek, Andrzej Bryś
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Department of Chemistry
Rapeseed oil as a source of unsaturated fatty acids in human milk fat substitutes obtained by the interesterification process

13^{10}–13^{30} Karol Parchem, Agnieszka Bartoszek
Gdansk University of Technology, Faculty of Chemistry, Department of Food Chemistry, Technology and Biotechnology
Bioactive phospholipids present in foods and products of their hydrolysis as preventive factors in civilization diseases

13^{30}–14^{00} **SUMMARY AND CLOSING OF THE CONFERENCE**

14^{00} **LUNCH**

Posters

GENETICS AND BREEDING

1. Kamila Nowosad[1], Alina Liersch[2], Wiesława Popławska[2], Jan Bocianowski[3]
[1] Wroclaw University of Environmental and Life Sciences, Department of Genetics, Plant Breeding and Seed Production
[2] Plant Breeding and Acclimatization Institute – National Research Institute, Department of Oilseed Crops, Poznań
[3] Poznan University of Life Sciences, Department of Mathematical and Statistical Methods
Genotype by environment interaction for seed yield in winter oilseed rape (*Brassica napus* L.) using additive main effects and multiplicative interaction model

2. Agnieszka Dobrzycka[1], Joanna Wolko[1], Jan Bocianowski[2], Kamila Nowosad[3]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] Poznan University of Life Sciences
[3] Wrocław University of Environmental and Life Sciences
Phenotypic variation of yield related traits in DH lines and hybrids of winter oilseed rape (*Brassica napus* L.)

3. Galina Mozgova, Valiantsina Lemesh, Jadwiga Piliuk
The Institute of Genetics and Cytology at the National Academy of Sciences of Bielarus, Minsk
PCR assay of oilseed rape varieties for development of F1 hybrids based on CMS *ogura*

4. Tomasz Szymański, Michał Rokicki
Poznańska Hodowla Roślin Spółka z o.o.
Response of various types of winter oilseed rape to different weather conditions based on a research conducted at Poznańska Hodowla Roslin Sp. z o.o., Plant Breeding Station Wiatrowo

5. Stanisław Spasibionek, Teresa Piętka, Krystyna Krótka, Jan Krzymański.
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
The possibilities for further reducing the glucosinolate contents in seeds of double low rapeseed (*Brassica napus* L.)

6. Janetta Niemann[1], Andrzej Wojciechowski[1], Aldona Jasińska-Stępniak[2], Magdalena Olender[1]
[1] Poznan University of Life Sciences, Department of Genetics and Plant Breeding
[2] Poznan University of Life Sciences, Department of Biochemistry and Food Analyses
Analysis of fatty acids composition in *Brassica* interspecific hybrids seeds

7. Kamila Nowosad[1], Henryk Bujak[1], Andrzej Kotecki[1], Jan Szopa-Skórowski[2]
[1] Wrocław University of Environmental and Life Sciences
[2] University of Wrocław
Genetic variability in flax breeding material based on microsatellite markers

8. Magdalena Kluza-Wieloch[1], Irmina Maciejewska-Rutkowska[2], Ilona Wysakowska[1], Grażyna Silska[3]
[1] Poznan University of Life Sciences, Department of Botany
[2] Poznan University of Life Sciences, Department of Forest Botany

[3] Institute of Natural Fibres and Medicinal Plants in Poznan
Morphological variability of flax cultivars (*Linum usitatissimum* L.) of different geographical origin

9. Magdalena Walkowiak[1], Grażyna Silska[2], Krzysztof Michalski[1], Marcin Praczyk[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] Institute of Natural Fibres and Medicinal Plants in Poznan
Characterization of a collection of linseed (*Linum usitatissimum* L.) with varying fat content and composition of fatty acids in seed oil

10. Marcin Praczyk, Grażyna Silska
Institute of Natural Fibres and Medicinal Plants in Poznan
Preliminary results of new flax varieties breeding with high fiber and seed yield to increase the profitability of cultivation

11. Magdalena Walkowiak, Krzysztof Michalski, Krystyna Krótka
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
High-morphine lines of oilseed poppy (*Papaver somniferum* L.)

BIOTECHNOLOGY

12. Katarzyna Lechowska[1], Szymon Kubala[2], Łukasz Wojtyla[1], Muriel Quinet[3], Stanley Lutts[3], Małgorzata Garnczarska[1]
[1] Adam Mickiewicz University in Poznan, Department of Plant Physiology
[2] Institute of Biochemistry and Biophysics Polish Academy of Sciences in Warszawa, Department of Protein Biosynthesis
[3] Groupe de Recherche en Physiologie Végétale (GRPV), Earth and Life Institute – Agronomy (ELI-A), Université catholique de Louvain, Belgium
Water status in primed rape seeds during germination – NMR, SEM analysis and expression of aquaporins

13. Anna Grygier, Magdalena Rudzińska
Poznan University of Life Sciences, Department of Food Chemistry and Instrumental
Microorganisms in polyunsaturated fatty acids production

14. Agnieszka Dobrzycka[1], Joanna Wolko[1], Katarzyna Gacek[1], Philipp E. Bayer[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] School of Plant Biology, University of Western Australia, Perth
Genome-Wide Association Study (GWAS) to identify markers for oil, protein and fibre content in winter oilseed rape (*Brassica napus* L.) seeds

AGRONOMY

15. Władysław Malarz, Marcin Kozak, Andrzej Kotecki
Wrocław University of Environmental and Life Sciences, Department of Crop Production
The effect of TS biostimulators on morphological features and yield of winter rape

16. Tadeusz Wałkowski
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Yields of oilseed rape depending on increasing doses of nitrogen applied to the soil not limed and limed in habitat conditions the region of Podlasie

17. Marek Wójtowicz[1], Ewa Jajor[2], Andrzej Wójtowicz[2], Marek Korbas[2], Franciszek Wielebski[1]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] Institute of Plant Protection – NRI in Poznan
Effect of protection against pathogens on yield of winter oilseed rape cultivars under high level of nitrogen fertilization

18. Franciszek Wielebski, Marek Wójtowicz, Stanisław Spasibionek
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Yield and yield seed components of brightly and brown linseed varieties (*Linum usitatissimum* L.) in response to nitrogen and sulphur fertilization

19. Franciszek Wielebski, Marek Wójtowicz, Stanisław Spasibionek
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Effect of nitrogen and sulphur fertilization and plant density on fat content and fatty acid composition in oil of brightly and brown linseed varieties (*Linum usitatissimum* L.)

20. Anna Wondołowska-Grabowska[1], Marcin Kozak[1], Elżbieta Skrzyńska[2], Andrzej Kotecki[1], Sylwia Lewandowska[1]
[1] Wrocław University of Environmental and Life Sciences, The Faculty of Life Sciences and Technology
[2] Cracow University of Technology, Faculty of Engineering and Chemical Technology
Chemical analysis of selected linseed varieties characterized by different ability of microelements (Cu, Mn, Fe, Ni, Zn) and heavy metals (Cd, Pb) absorption from soil

21. Martina Větrovcová, Jana Poslušná
Agritec Plant Research Ltd., Šumperk, Czech Republic
Content of cadmium in poppy seeds (*Papaver somniferum* L.) in selected locations in the Czech Republic

DISEASES AND PESTS

22. Eva Plachká[1], Jana Poslušná[2]
[1] OSEVA PRO s.r.o., o.z. Výzkumný ústav olejnin Opava,
[2] Agritec Plant Research s.r.o., Šumperk, Czech Republic
The current occurrences of oilseed rape diseases on selected locations in the Czech Republic and the treatment indication

23. Jana Poslušná[1], Ewa Plachká[2]
[1] Agritec Plant Research s.r.o., Šumperk, Czech Republic
[2] OSEVA PRO s.r.o., o.z. Výzkumný ústav olejnin Opava
Testing the susceptibility of *Leptosphaeria* spp. and *Sclerotinia sclerotiorum* pathogens against selected fungicides

24. Elżbieta Starzycka-Korbas[1], Michał Starzycki[1], Wojciech Rybiński[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] The Institute of Plant Genetics of the Polish Academy of Sciences in Poznan
Williams test and its modification in the study of resistance oilseed rape *Brassica napus* L. to *Leptosphaeria* sp. infection

25. Elżbieta Starzycka-Korbas[1], Michał Starzycki[1], Wojciech Rybiński[2], Piotr Kamiński[3]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] The Institute of Plant Genetics of the Polish Academy of Sciences in Poznan
[3] Research Institute of Horticulture in Skierniewice
Comparison of interspecific hybrids resistance seedlings in vitro and in vivo plants after pathogen inoculation of *Leptosphaeria* sp., *Alternaria* sp

26. Ilona Świerczyńska, Agnieszka Perek, Katarzyna Pieczul, Ewa Jajor
Institute of Plant Protection – NRI in Poznan
The sensitivity of *Sclerotinia sclerotiorum* to active ingredients of fungicides used for the oilseed rape protection

27. Małgorzata Jędryczka, Joanna Kaczmarek
The Institute of Plant Genetics of the Polish Academy of Sciences in Poznan
Pathotypes of *Plasmodiophora brassicae*, the cause of clubroot, in Poland

28. Henryk Woś[1], Ewa Jajor[2], Agnieszka Perek[2], Marek Korbas[2]
[1] Polish Association of Plant Breeders
[2] Institute of Plant Protection – National Research Institute in Poznan
In search of forms resistant to clubroot (*Plasmodiophora brassicae* Wor.) within the species of field mustard (*Brassica rapa* L.)

29. Jiří Havel
OSEVA Research and Development Ltd., Czech Republic
The unusual abiotic and biotic damages of oilseed poppy (*Papaver somniferum* L.)

30. Mirosław Nowakowski[1], Paweł Skonieczek[1], Łukasz Matyka[1], Marcin Żurek[1], Teresa Piętka[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Bydgoszcz
[2] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
Biomass yield and the impact of selected lines and cultivars of white mustard on the population of *Heterodera schachtii*

31. Andrzej Wojciechowski[1], Marek Mrówczyński[2], Jacek Broniarz[3], Janetta Niemann[1], Henryk Wachowiak[2], Kamil Kolan[1]
[1] Poznan University of Life Sciences, Department of Genetics and Plant Breeding
[2] Institute of Plant Protection – National Research Institute in Poznan
[3] Research Centre for Cultivar Testing in Słupia Wielka
Susceptibilities of winter oilseed rape cultivars to infestation by root magot (*Delia radicum*)

ANALYTICAL METHODS AND PROCESSING

32. Marzena Gawrysiak-Witulska[1], Jolanta Wawrzyniak[1], Robert Rusinek[2]
[1] Poznan University of Life Sciences, Faculty of Food Science and Nutition, Institute of Food Technology of Plant Origin
[2] The Bohdan Dobrzański Institute of Agrophysics of the Polish Academy of Sciences in Lublin
The influence of rapeseed moisture content and storage temperature on changes in technological quality of produced oil

33. Katarzyna Ratusz[1], Edyta Popis[1], Maltam Shamilova Elshan[2]
[1] Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
[2] Baku State University, Faculty Ecology and Soil Science, Department of Ecological Chemistry
The influence of storage conditions on the quality and oxidative stability of *Camelina sativa* cold-pressed oil

34. Anna Żbikowska[1], Małgorzata Kowalska[2], Mariola Kozłowska[3] Anna Grzybowska[1]
[1] Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
[2] Kazimierz Pulaski University of Technology and Humanities in Radom, Faculty of Materials Science, Technology and Design, Department of Chemistry
[3] Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Department of Chemistry
Effect of natural antioxidants on quality of lipid fraction in the fat sponge-cakes

35. Karol Mińkowski, Artur Kalinowski, Anna Krupska
Institute of Agricultural and Food Biotechnology in Warszawa
The effect of preparation of seeds and choking of mass of seeds in expeller press on pressing parameters and quality of linseed oil

36. Karol Mińkowski, Artur Kalinowski, Anna Krupska
Institute of Agricultural and Food Biotechnology in Warszawa
Influence of flaking and low-temperature hydrothermal treatment of flakes on pressing process parameters and quality of linseed oil

37. Karol Mińkowski, Artur Kalinowski, Anna Krupska
Institute of Agricultural and Food Biotechnology in Warsaw
Effect of enzymatic pretreatment of seeds on pressing process parameters and quality of linseed oil

38. Lenka Endlová[1], Andrea Rychlá[1], Zuzana Navrátilová[2], Viktor Vrbovský[1]
[1] OSEVA PRO s.r.o., o. z. Výzkumný ústav olejnin, Opava
[2] University of Ostrava, Faculty of Science, Department of Chemistry
Estimation of fatty acid content in the intact seed of oilseed crops using near infrared spectroscopy with regard to the quality of the resulting vegetable oil

39. Sylwia Onacik-Gür, Edyta Popis, Anna Żbikowska, Katarzyna Ratusz
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology

Studies on the effect of rapeseed and linseed oil fatty acids composition on selected parameters of ethylcellulose oleogels

40. Edyta Popis, Katarzyna Ratusz, Zuzanna Bajorek, Krzysztof Krygier
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
Assessment of the oxidative stability of linseed oil

41. Edyta Popis, Katarzyna Ratusz, Krzysztof Krygier
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology
Effect of seed pretreatment on poppy oil quality

42. Artur Kalinowski
Institute of Agricultural and Food Biotechnology in Warsaw
The effect of tempering the solid content of cocoa butter selected sample

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Olive oils extra virgin – characteristics of selected species based on fatty acid composition

BIOLOGICAL VALUE OF OIL AND MEAL

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Chemical characteristics of meals obtained from new genotypes of yellow and black-seeded winter rapeseed

45. Elżbieta Kondratowicz-Pietruszka
Cracow University of Economics, Faculty of Commodity Science
The quality of selected margarines Polish market

46. Małgorzata Wroniak, Agnieszka Rękas, Katarzyna Ratusz
Warsaw University of Life Sciences, Faculty of Food Sciences, Department of Food Technology
The influence of impurities in raw material on sensory quality and physico-chemical properties of oil

47. Małgorzata Wroniak, Agnieszka Rękas, Anna Piekut
Warsaw University of Life Sciences, Faculty of Food Sciences, Department of Food Technology
The effect of hydration and microwave heating of rapeseed on the quality and yield of oil

48. Małgorzata Wroniak, Katarzyna Ratusz, Agnieszka Rękas, Daria Prejs
Warsaw University of Life Sciences, Faculty of Food Sciences, Department of Food Technology
The evaluation of selected quality wheat and potato snacks fried in fat with different thermal stability

49. Agnieszka Kita, Joanna Miedzianka, Agnieszka Nemś
Wroclaw University of Environmental and Life Sciences, Department of Food Storage and Technology
Characteristics of physico-chemical properties of flours from meals after oil cold-pressing

50. Sylwester Czaplicki, Małgorzata Tańska, Dorota Ogrodowska
University of Warmia and Mazury in Olsztyn, Faculty of Food Sciences, Chair of Food Plant Chemistry and Processing
The use of natural antioxidants of sea buckthorn and amaranthus oils to the oxidative stabilization of bio-oil from the seeds of viper's bugloss

51. Beata Paszczyk, Ryszard Rafałowski, Joanna Klepacka
University of Warmia and Mazury in Olsztyn, Chair of Commodity Science and Food Analysis
Composition of fatty acids in refined vegetable oils occurring in trade

52. Ryszard Rafałowski, Joanna Klepacka, Beata Paszczyk
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The content of the tocopherols in refined vegetable oils occurring in trade

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The effect of rapeseed pretreatment by microwaves on the content of phenolic compounds in the extracted oil

54. Dominik Kmiecik[1], Józef Korczak[1], Magdalena Rudzińska[1], Raquel Figuerola Canto[2]
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The possibility of using natural and synthetic polyphenols to stabilize of phytosterols from rapeseed oil

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Oil of white mustard (*Sinapis alba* L.) a rich source of phytosterols

ORAL PRESENTATION

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Structural genome rearrangements associated with resistance and quality traits in oilseed rape

Genome rearrangements in the allopolyloid *Brassica napus* genome have been shown to generate selectable genetic variation that can contribute to advantageous phenotypes, potentially including disease resistance and yield. We are performing comparative analysis of structural genome organization and allelic diversity associated with quality traits and resistance factors to important oilseed rape diseases. In particular we aim to determine how structural chromosome rearrangements affect quantitative trait loci (QTL) contributing to multiple pathogen resistances and seed qualtity and how these can be used to improve resistance in breeding. Parental lines from doubled-haploid (DH) mapping populations, including synthetic *B. napus* donors of quantitative disease resistance and yield factors, were resequenced to determine subgenomic structural variants including homoeologous and non-homoeologous chromosome exchanges. Whole-genome resequencing of the mapping parents allows us to calculate copy number variation along the genome and differentiate segments of altered copy number in comparison to the assembled genome of the European winter oilseed rape cultivar 'Darmor-bzh'. These segments represent candidates for insertions/deletions. Sequencing and genome-wide SNP-based genotype data from DH lines were then utilised to trace structural variants in the segregating progenies and compare their positions to those of QTL for disease resistance and seed quality traits. Preliminary results suggest that resistance and seed quality loci can potentially be influenced by homoeologous exchanges. These can cause gene dosage changes that may confer a selective advantage. Analyses of genes in exchanged segments associated with resistance and seed quality QTL is a promising new approach to deciphering the genetic basis of quantitative resistances and yield in oilseed rape. We expect that knowledge about copy number variation and rearrangements will help to improve and focus selection processes in breeding for resistance, yield and quality traits in modern rapeseed lines.

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Institute of Animal Reproduction and Food Research of Polish Academy of Sciences

Flaxseed lignans: methods of their determination, biological and antioxidant activity

Flaxseed (*Linum usitatissimum* L.) has been focus of interest of nutritionist due to the potential health benefits. It is associated with the presence in this plant alpha-linolenic acid and lignan secoisolariciresinol diglucoside (SDG). The seeds of this plant are the richest

source of lignans. In human intestinal tract SDG is converted by bacteria to mammalian lignans: enterodiol (ED) and enterolactone (EL). Due to the similarity in the chemical structure of ED and EL and oestradiol both compounds can act as weak oestrogenic/ antioestrogenic compounds.

This lecture is focused on the chemical structure of lignan macromolecule, methods of its extraction from defatted flax seeds, its chemical and enzymatic hydrolysis, methods of determinations using HPLC method, antioxidant properties of crude extract and pure SDG and its aglycone (secoisolariciresinol SECO) and anticancer activity of lignans.

Marcus Jansen
LemnaTec, Aachen, Niemcy

Phenotyping – characterising plant properties at multiple scales

In recent years, the value of sensor based plant phenotyping has been firmly established by breeders and scientific publications across the world. Although early work involved pot grown plants in laboratory and greenhouse environments, the demand for systems to address both smaller and larger plant samples is also growing.

At the lower end, systems aim to characterise plants, in particular roots of model plants growing on agar-plates. At the higher end, scientists and especially breeders also need solutions to phenotype field-grown plants.

LemnaTec's Field Scanalyzer measures comprehensive sets of phenotypic data on a plot area using a multi-sensor measuring head mounted on a gantry crane. In addition to this deep-phenotyping approach for a single field plot, LemnaTec is also developing wheeled vehicles equipped with sensor technology that can be moved between different breeding fields.

LemnaTec is establishing image acquisition procedures and data analysis pipelines for both field and laboratory applications. The latter will enable scientists to quantify phenotypic properties of seedlings on agar-plates from germination to the early developmental stages with temporal and spatial resolution. Such agar-plate trials are widespread for gene function studies in basic research. Similarly, we are addressing the demand for analysing seedlings grown in small soil-filled pots.

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Research potential of Wielkopolska Centre of Advanced Technologies

Wielkopolska is among the leading academic centres in Poland, harboring a great R&D potential. The essence of the comprehensive knowledge transfer model, generated in the city of Poznań, is building an effective relationship between invention, pursued at universities and research institutes, and innovation by creating all necessary elements for the effective transfer of knowledge, especially Polish scientific and technological achievements, to business practice.

At the core of this model is the Wielkopolska Centre for Advanced Technologies (WCAT) in Poznań, a multi-disciplinary institution focused on design and characterization of new materials and biomaterials of multiple applications.

The main aim of the foundation of Wielkopolska Centre for Advanced Technologies – Materials and Biomaterials (WCAT) in Poznan, is to create a multidisciplinary research centre in the field of high-tech materials, biomaterials and nanomaterials based on recent achievements in fields related to chemistry, chemical technologies, physics, biotechnology, biology, medicine, pharmacy and agricultural sciences.

WCAT brings together the best specialists of natural and engineering sciences and is an infrastructural venture of the Poznań scientific community. The Centre is a consortium of five universities: Adam Mickiewicz University (AMU), which is the project coordinator, Poznań University of Technology, Poznań University of Life Sciences, Poznań University of Medical Sciences and Poznań University of Economics; four institutes of the Polish Academy of Sciences: the Institute of Bioorganic Chemistry, Plant Genetics, Human Genetics, and Molecular Physics; Institute of Natural Fibres and Medicinal Plants; and the Poznań Science and Technology Park of the Adam Mickiewicz University Foundation and City of Poznań. The project is based on the research know-how and credibility of leading scientists, working in the key institutes of the regions.

The objective of the multidisciplinary activity of the centre is to develop original methods for synthesis of chemicals, biochemicals and agrochemicals, called fine chemicals, and a new generation of biomaterials and nanomaterials and their precursors, designed in cooperation between the chemists, physicochemists and biochemists. These research activity will be followed by the development of advanced technologies and biotechnologies for the production of these fine (bio)chemicals and precursors of materials to be used in optoelectronics, ceramics, medicine, pharmacy, agriculture and other fields of high-tech industry.

The special mission of WCAT is to develop multidisciplinary projects involving fundamental research but simultaneously leading to advanced technologies and/or products subsequently implemented in incubators of the innovative firms localized in Poznań Science and Technology Park, and other industrial and technological parks, and innovative small and medium firms as well as by international industry. To reach the complex goals mentioned above, we committed to ensure permanent cooperation between all units of WCAT i.e. Centre of Chemical Technology and Nanotechnology, Centre of Industrial Biotechnology with a Greenhouse, Centre of Medical Biotechnology with an Animal House, Centre of Material Sciences with a Regional Laboratory of Unique Equipment, functioning as one research organism.

The vision of WCAT is to include existing organizations (universities, research institutes, and science-technology park) to act like one independent entity, which will generate synergies by combining the work of the best scientists, as an independent institute modeled on the Fraunhofer Society (most experienced of R&D Centres in Europe with 60–70 years tradition).

The WCAT project is co-financed (85%) by the European Regional Development Fund under the Operational Programme Innovative Economy 2007-2013 with total budget of 63 million euro. Operational phase of the Centre was started on 1st of December 2015.

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Beech oil – the forgotten source of bioactive compounds

European beech (*Fagus sylvatica* L.) is a common leafy tree growing in southern, western and north-west Poland. Beechnuts were for centuries a common element of the peasant diet. Nuts were eaten raw or oil was pressed from them. According to historians reports oil was produced by the people in south part of Poland (around Zakopane, Limanowa, Nowy Sącz, Rzeszów, Przemyśl and Zamość). However, this practice in the second half of the nineteenth century began to disappear. The observed currently development of "bio", "organic", "natural" or "ecological" products market results in an increase of interest in unusual oil raw materials. Hence the idea of utilization of traditional source of oil – beechnuts appears. The requirements of contemporary processing and "bio" food market make it reasonable to characterize beechnuts as a raw material in terms of physicochemical properties and nutritional value particularly taking into account the content of bioactive compounds. Hence the aim of the current study was to determine the basic physicochemical parameters of the cold-pressed beech oil and the content of fatty acids, tocopherols, phytosterols, β-carotene and chlorophyll.

Beechnuts were purchased from Wyłuszczarnia Nasion in Klosnowo. Oil was cold-pressed using Farmet Uno press (Farmet, Czech Republic). Physicochemical characteristics of the oil include color (CIE, L*a*b*), refractive index, density, peroxide value, acidic value, iodine value and anisidine value determination. Fatty acid composition, the content of tocopherols, phytosterols, β-carotene and chlorophyll were also determined.

The dominated fatty acids in the obtained oil were oleic (38.6%) and linoleic (38%). Unsaturated fatty acids accounted for 81.9% of total fatty acids contained in the tested product. Beech oil was rich in tocopherols (110 mg/100 g), the dominant homologue was γ-tocopherol (75.4 mg/100 g). A high content of γ-tocopherol may determine a health-promoting action of the oil beech due to the anti-inflammatory action of this homologue. The content of phytosterols in the tested product was 1498 mg/kg, with predominant β-sitosterol (71.51% of total phytosterols). Investigated beech oil contained 10.68 mg/kg of β-carotene, which was significantly higher value when compared with other cold-pressed oils obtained from unconventional raw materials (milk thistle, chia, white poppy seeds, blue poppy seeds, black cumin). The product tested was characterized by relatively low content of chlorophyll (2.56 mg/kg). Low concentration of this substance is preferably because of possible oil photooxidation in the presence of the mentioned plant pigment.

The cold-pressed beech oil due to favorable organoleptic characteristics and the content of bioactive compounds (especially tocopherols) can be an interesting proposition for both consumers interested in traditional and ecological food as well as chefs looking for inspiration for new dishes. This product may expand the offer of small oil mills operating at farms, including ecological and agritourism farms.

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Molecular assays in winter oilseed rape breeding programs at the IHAR – NRI, Poznan Division

At the Plant Breeding and Acclimatization Institute – NRI in Poznan, innovative selection methods were implemented by development of universal genetic markers, SCAR and SNaPshot, respectively, for two agronomically important trait categories: (1) concerning the *ogura* male-sterile cytoplasm (the *ogura* CMS) and the *Rfo* restorer gene (Mikołajczyk et al. 1998, 2008, 2010a, 2011, Polish Patent No: PAT.212433 dated 02.11.2012, Liersch et al. 2015), both combined with the *ogura* hybrid system used worldwide for obtaining high-yielding F1 hybrids, and also (2) comprising oilseed rapeseed seed oil quality, low linolenic acid (C18:3) content due to mutated genes of FAD3 desaturases in the *B. napus* A and C genomes, respectively (Mikolajczyk et al. 2010b, 2011, Bocianowki et al. 2012, Polish Patent No: PAT.211126 dated 11.05.2012, Spasibionek et al. 2015), developed as a result of co-operation with Adam Mickiewicz University of Poznan. The developed genetic markers are specific for the low-linolenic mutant M681 line and its recombinants (Spasibionek 2006), as well as for the spring Canadian 'Apollo' cultivar. Moreover, such point mutations were discovered also in oilseed rape low-linolenic mutant lines developed at other laboratories worldwide (Hu et al. 2006, Yang et al. 2012).

Both categories of markers are versatile, thus can be widely applied for monitoring genotypes and recombinants developed with the use of the *ogura* male sterility system as well as low-linolenic oilseed rape mutants. Till now, up to 7 000 winter oilseed rape genotypes included in different research and breeding programs were analyzed at the PBAI-NRI. Moreover, STR Short Tandem Repeats) loci markers were used for assessment of genetic diversity and further association analyzes (Liersch et al. 2015).

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Genome-wide association study of genetic control of fatty acid composition in oilseed rape (*Brassica napus* L.) seed

Fatty acids in seeds affect seed germination and seedling vigour and their composition determines the quality of seed oil for nutritional and industrial purposes. In this study, genome-wide association study (GWAS) was applied to elucidate complex genetic network regulating seed fatty acid composition in oilseed rape (*Brassica napus* L.). We identified 90 205 single nucleotide polymorphisms (SNPs) in 60 doubled haploid (DH) mapping population lines using high-resolution skim genotyping by sequencing (GBS) (Illumina® HiSeq). The SNPs were mapped to publicly available *B. napus* reference genome and used for association mapping with seed fatty acids. As a result, significant association peak was detected on chromosome A05 for oleic and linoleic acids. Several candidate genes were identified in the associated genomic region including *B. napus* orthologs of Fatty acyl-ACP thioesterase B (*FATB*), Fatty Acid Desaturase (*FAD5*) known to play a role in seed fatty acid composition. This study provides fundamental resource for oilseed rape genetics research and breeding and demonstrates that this approach can be used as a powerful tool for dissecting complex traits in this crop species.

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Assessement of self-incompatibility and cross compatibility of chosen cultivars and accessions of four mustard species (*Brassicaceae*) on the basis of pollen tube observations and set seeds

Self-incompatibility (SI), where self-pollen is prevented from germinating on the stigma or penetrating the pistil tissue, is a widespread mechanism promoting outcrossing and it is ruled by S gene (Hiscock. & Kűes 1999) SI systems are classified according to the way of S allel expression. If it is autonomously expressed in pollen it is causing gametophytic self-incompatibility (GSI). In the case where S gene is expressed in paternal diploid anther it is causing sporophytic self-incompatibility (SSI). In *Brassicceae* exists SSI system and it is controlled by a single, highly polymorphic locus called the S-locus, in which over thirty S-allels were identified (Thompson 1981). S genes can be mapped in different loci and demonstrate to each other the total dominance and co-dominance (Thompson 1983, Wojciechowski 1985, Nasrallah & Nasrallah 1993, McCubbin & Kao 2000). Moreover, some S alleles are very flexible to the temperature and according to Nasrallah & Nasrallah (1993), Visser (1977) and Thompson (1983) the phenomenon of SI depends on whether SSI is conditioned by S allels of "high" domination or by S allels of "low" domination series. There are differences concerning SI or self-compatibility (SC) not only between mustard species, but also between clones within the same species of mustard (Zeng & Cheng 2014).

In this work the self-incompatibility (SI) and cross compatibility (CC) of two amphidiploid (*B. carinata* and *B. juncea*) and two diploid (*B. hirta* and *B. nigra*) species of mustard in the intra- and interspecific crosses performed under greenhouse conditions were investigated. The conclusion, concerning SI or CC was made on the base of Pollen Grain Germination Index (PGI), which was calculated based on the observation of pollen grains germination on the stigma and pollen tube penetration in various parts of the pistil (Niemann et al. 2015). These self- or cross-combinations in which the PGI was lower than 2. were considered as self-incompatible or cross-incompatible. The second method stating self- or cross-compatibility was estimated based on the setting pods and seeds.

Based on the obtained data, it was found that the most self-incompatible were two diploid species, *B. nigra* and *B. hirta*. Two amphidiploid species, *B. juncea* and *B. carinata* showed different SI or CC depending on the crossed ecotypes within species and between species.

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Possibility of breeding and cultivation of fals flax (*Camelina sativa* (L.) Crantz) in Poland

Fals flax (*Camelina sativa* (L.) Crantz) is a one of the oldest crop from *Brassicacea* family. It was cultivated in Central and Eastern Europe and Scandinavia since the Bronze Age. In Poland camelina had a big importance as an oil crop up to sixties of the 20th century. Oil "rydzowy" obtained from camelina seeds have a high content (up to 90%) of unsaturated fatty acid: oleic, linoleic, linolenic and eicosenic. These are extremely beneficial fatty acids in the diet and human health. In its composition are also vitamins A, E and from B group, lecithin, micro and macro elements. A revival of interest in camelina on the world in recent years is as oil crop for sustainable agriculture which could be cultivated at poor soil and from which oil is particularly suitable for the production of biofuels. Of particular interest is the possibility of using camelina oil to produce biofuel for aircraft.

In Poland camelina breeding is conducted only in Department of Genetics and Plant Breeding Poznan University of Life Sciences. Works with camelina started in early nineties. In first step, after gamma rays irradiation of seeds winter variety Przybrodzka a several mutants were obtained including "clavate" mutant which have compact inflorescence. In effect of genetic and breeding works with this mutant a number of new breeding line with changing morphotype were selected out. The trials have shown that the new lines of winter camelina had the potential to yield reaching 3.0 t/ha and yielding 25–30% higher in comparison to the variety Przybrodzka. As a result, in 2012 two winter camelina varieties MACZUGA and LUNA were granted protection of the national Plant Breeders' Rights.

The breeding spring form of camelina started in 1999 from the gathering 39 genotypes origin from European collection (German, Austrian, France, Russian, Bulgarian, Poland). As a result of diallel crossing of 8 best genotypes, and next pedigree selection new spring camelina lines were selected out. These lines during trials conducted in 2008–2010 yielded 15–20% higher in comparison to variety Borowska. The best line was granted protection of the national Plant Breeders' Rights as variety OMEGA.

For continuing further effective breeding the suitable germplasm is needed. However resources of camelina genotypes in the world are very short, and mainly limited to the old varieties and landrace mainly from Russia, Ukraine, Germany and Poland eg. in Canadian

collection is 136 genotypes including 77 from Germany, Poland and Russia. The collection in Germany have 265 genotypes, USA 64 genotypes and the National Centre for Plant Genetic Resources in Radzików gathered 100 genotypes of camelina. Especially is lack of winter camelina genotypes.

The increased interest in camelina caused to start in the last 10 years of new genetic research: studies of genetic similarity of gathering genotypes, looking for molecular markers and the recently sequenced the entire genome of camelina. In the ongoing breeding work the effort to obtain genotypes with greater 1000-SW and searched for plants with altered fatty acid composition has been made. In order to broadening the variability the wide crosses were carried out and the hybrids between camelina and canola by protoplast fusion has been obtained. Application of new developments in molecular genetics and biotechnology creates hope for further progress in breeding new varieties of *Camelina sativa*.

Traditions of cultivation of camelina in Poland are very large. Even in the late fifties of the 20th century in the Wielkopolska there were over 20 000 hectares of camelina. Poland currently has a number of factors to increase the cultivated area of camelina: a large acreage of poor soils suitable for cultivation, a new higher yielding varieties, companies which bought seeds pressed for oil "rydzowy", developed technology production of biofuels from camelina oil. It is estimated that potentially in Poland 50–70 thousand ha of camelina could be cultivate.

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Studies on the variability of antioxidant lipophilic and hydrophilic compounds content in the seeds of new breeding rapeseed lines

Among the most important bioactive compounds in rapeseed oil are tocopherols (-T). These compounds have an important role in the antioxidant activity of the oil – that is in the protection it provides against the oxidation of polyunsaturated fatty acids. An equally important role of tocopherols in the human body is their physiological antioxidant effect, which protects the body against the long-term health risks associated with oxidative stress. One special feature of rapeseed is its tenfold higher concentration of phenolic compounds than other oilseeds. These compounds possess high antioxidant potential, but to date have not been made use of, due to the fact that during the process of pressing the oil from the seeds, these compounds remain in the pomace. The qualitative features of rapeseed are being further improved through research aimed at developing varieties with larger contents of fat, protein, and biologically active substances. The use of doubled haploid (DH) plants in cultivation increases the efficiency of selection of the qualitative characteristics, and especially of the quantitative characteristics. In a large population of doubled haploid lines derived from a single hybrid, genotypes with significantly different characteristics can be observed. DH lines derived from an F1 hybrid represent a broad range of possible genetic recombinational characteristics of the parental lines and are the ideal material for selection.

The objects of the study were two populations of double haploid lines of winter black seeded rapeseed (*Brassica napus* L.). In the field experiments with two paternal lines (A3-226, MI-305) 130 DH lines have been sown (TOK-1 and TOK-2). Population TOK-1 (75 DH lines) was obtained as a result of DH MI-305 (characterized by high content of total tocopherols) and DH A3-226 (characterized by low content of total tocopherols) crossing. Population TOK-2 (55 DH lines) was a result of reciprocal process. Tocochromanols and phenolic compounds were determined using HPLC method.

The population TOK-1: (9, 15, 17, 69, 68) have higher total tocopherols content in comparison to paternal line MI-305. However in population TOK-2 only one line (28) was characterized by higher tocopherols content. The content of individual homologues and total tocopherols content in both populations (TOK-1, TOK-2) differ significantly. It suggests essential impact of environment on the tocopherols level.

The chromatographic analysis of hydrophilic antioxidants demonstrated the presence of sinapine, sinapic acid (cis, trans) and methyl ester of sinapic acid in rapeseed seeds. The study of the sinapic acid derivatives content showed the occurrence of DH lines with low sinapine concentration (population TOK-1: 6,17, 32, 40, 54, 64 and population TOK-2: 8, 11, 37, 38, 46, 55). Those lines are possibly starting material to breed new low sinapine rapeseed varieties. DH lines (TOK-1: 16, 42, 53, 54 and TOK-2: 34, 37, 38, 50) contain the higher concentration of sinapic acid. The content of this compound may influence the antioxidant potential of oil obtained from new rapeseed varieties. The lack of statistically significant influence of DH reciprocal process on the total phenolic compounds content in populations TOK-1 (DH MI-305 x DH A3-226) and TOK-2 (DH A3-226 x DH MI-305) have been shown.

The statistical analysis revealed the significant correlation between lipophilic and hydrophilic antioxidant content. In the population TOK-1 a correlation between α-T and sinapic acid ($r = 0.28$; $p = 0.016$), γ-T and sinapic acid ($r = 0.31$; $p = 0.008$), γ-T and methyl ester of sinapic acid ($r = 0.27$; $p = 0.020$), total tocopherols and sinapic acid ($r = 0.41$; $p < 0.0001$) as well as total tocopherols and methyl ester of sinapic acid ($r = 0.28$; $p < 0.0016$) has been shown. In the case of TOK-2 population a positive correlation only between γ-T and sinapic acid ($r = 0.29$; $p < 0.033$) likewise total tocopherols and sinapic acid ($r = 0.32$; $p < 0.016$) was observed.

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Products formed during thermo-oxidative degradation of phytosteryl esters

Hypercholesterolemia is an important risk factor for the development of cardiovascular diseases. A daily intake of 2 g of phytosterols/phytostanols reduce total and LDL plasma cholesterol levels of approximately 10%. However, phytosterols/phytostanols are prone to oxidation and they form oxidation products with controversial biological effects.

The aim of the study was quantity and quality determination of thermo-oxidative degradation products of stigmasteryl esters after their heating at 180°C in the presence of oxygen. Stigmasteryl esters were obtained by esterification of stigmasterol with fatty acids. The purity of obtained esters was evaluated by H^+NMR and GC-MS. After heating the oxidation products were analyzed to describe: quantitative changes of fatty acids

and stigmasterol moieties (GC-FID), stigmasterol oxidation products (GC-FID, GC-MS), volatile compounds (SPME/GC-MS), cytotoxicity on tumor cells.

It was found that thermo-oxidation caused degradation of stigmasteryl esters. The degree of degradation is directly affected by temperature, time and kind of fatty acid moiety in stigmasteryl ester. After heating volatile compounds were formed from fatty acids and steryl moieties. Among volatiles mainly aldehydes, ketones, alcohols and hydrocarbons were found. Stigmasteryl esters disintegrated and formed stigmasterol oxidation products (hydroxy-, keto- and epoxy-) and high-molecular compounds (dimers and oligomers). Stigmasteryl esters and their degradation products have a cytotoxicity effect on tumor cells.

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Promotion of rapeseed oil and its perception by consumers – chances and dangers

Polish Association of Oil Producers has been realized informational & promotional campaign „Love rapeseed oil" since 2011. The campaign is co-financing by the European Commission and Republic of Poland, and also by oil producers. The first edition of the campaign took place in 2011–2014, and now the second edition of the programme is planned for 2015–2018. The main objective is to strengthen consumer awareness of nutritional and health values of rapeseed oil. Program activities include: press advertorials, experts and idea positioning in TV programming, information and sampling actions at points of sales, educational activities focused on nutrition dedicated to experts and journalist (seminars, publications),teachers and school professionals responsible for children's education in terms of eating behaviors, comprehensive digital activities (website www.pokochajolejrzepakowy.eu, search engine marketing, remarketing, social media – Facebook „Miej więcej oleju w głowie", bloggers, display campaigns).

First 3-years edition of programme „Fall in love with rapeseed oil" (successfully completed in 2014) with increase of awareness of values of rapeseed oil – each one on four consumer choose rapeseed oil due to health aspects and campaign activities met very good response of consumers.

Actually (2015/2016) we can observe allegations for rapeseed oil, which destroy its perception. Success from breeding "00" varieties is treated as implementation of GMO varieties on Polish market while society is against GM organisms. Low erucic acid is treat as poison in oil. Using glyphosate before harvest of rapeseed found negative perception. Part of consumers find rafination process, not as cleaning from pesticides but as removal all valuable components naturally existed in rapeseed. Promoting exotic oils such as coco oils and rye oil is based on negation of fry properties rapeseed oil, usually used for frying.

Multi-years campaigns managed by The Polish Association of Oil Producers for promoting rapeseed oil are important chance to build good perception, but as dangers we can say allegations mention earlier. These dangers are enunciate by nature-therapists and distributed and copy by Internet users.

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Evaluating the quality of market linseed oils

In recent years, growing consumer awareness regarding healthy eating, thus, there is growing interest in cold-pressed oils, which are considered to be natural, unprocessed products. Linseed oils constituted a particular group, characterized a suitable fatty acid composition preferred from a nutritional point of view. However, the high content of unsaturated fatty acids makes this oil easily undergoes the process of oxidation, which products may adversely affect human health. Therefore, it is important that available on the market oils should be of good quality and safe for consumers.

The aim of the study is to assess the quality and oxidative stability of linseed oils available on the market. The research material consisted of fifteen linseed oils purchased on the Warsaw market. In the analyzed oils the content of free fatty acids, the content of primary and secondary oxidation products, the amount of chlorophyll and carotenoids pigments were determined. Also, the fatty acid composition of linseed oils was analyzed. Additionally, an oil stability in the PDSC and Rancimat test at 100°C was designated. Moreover, total antioxidant capacity of the examined oils using of free radical DPPH was obtained.

Analyzed oils were characterized by different quality. The acid value was between 0.53–3.15 mg KOH/kg of oil. Furthermore, peroxide value of linseed oils was from 1.3 to 4.5 mEq O_2/kg, and the content of secondary oxidation products measure as *p* – anisidine value was from 0.07 to 3.43. Examined oils had from 44.85 to 60.56% of α-linoleic acid. The chlorophyll pigments content in oils was on a level of 0.06–0.79 mg pheophytin/kg, and the carotenoid pigments 18.43–42.25 mg β-carotene/kg. The results of the oxidation stability have exhibited low stability of linseed oils. In the Rancimat test induction time was between 2.85–4.96 h and in the PDSC test 56–125 minutes. The antioxidant activity of linseed oil expressed as Trolox equivalent was 2.10–3.10 μM/g of oil.

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The quality and safety of *Camelina sativa* oils

Cold-pressed oils, particularly rich in deficient fatty acids n-3, are gaining interest of polish consumers. Among them stands out the *Camelina sativa* oil, registered in the European Union as a Traditional Speciality Guaranteed. However, due to differences in the quality of raw material and the technology of cold-press, often the problem is oil quality especially its oxidation stability. The aim of this study was to assess the quality of cold-pressed *Camelina sativa* oils, purchased in retail outlets in Poland. In oils were determined fatty acid composition, acid value, peroxide value, anisidine value, oxidative stability using Rancimat test and PDSC, chlorophyll and carotenoids content, there was also determined Totox indicator.

The analyzed oils were characterized by good quality, meet the standards of requirements of the Codex Alimentarius (2009) for cold-pressed oils. The acid value varied

from 0,53 to 2,28 mg KOH/g, peroxide value between 1,13–4,49 meq O_2/kg. Oxidative stability index (100°C) of camelina oils varied from 3,31 to 6,12 h. The content of PUFAs was more than 57%, of which more than 35% of the ALA.

Key words: *Camelina sativa* oil, oxidative stability, Rancimat test, PDSC.

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Thermokinetic analysis of cocoa butter by differential scanning calorimetry

Cocoa fat (cocoa butter) provides than 50% of cocoa liquor. Its percentage content may vary depending on the species, season and the region where the seed was grown. The structure of triacylglycerols of cocoa butter is complicated. This fat consists of more than 75% of symmetric triacylglycerols (TAG), which are composed of fatty acids such as oleic acid (35%), stearic (34%), palmitic (26%) and other fatty acids (5%). Pure cocoa butter crystallizes depending on the composition of triacylglycerols in the six possible polymorphic forms (I–VI), wherein form I is the least stable and most stable form is V (the most desirable because it can progress to form VI), especially when it comes to the storage conditions. The differences between polymorphic forms of triacylglycerols are due to the different distances between the fatty acid chains, the various tilt angles with respect to the terminal methyl group of the chain and on to the arrangement of triacylglycerols in the process of crystallization. During the production of chocolate, for example, a process known as thermal tempering, is used to obtain the form V (ie. β_2) of cocoa butter with a melting point in the range of 32–34ºC.

The aim of this study was the analysis of thermal properties of two type of cocoa butter: natural and deodorized by using differential scanning calorimetry method.

The analysis were performed using the dynamic option of the DSC, with the following sample heating rates: 2.5 K/min., 4 K/ min., 5 K/min., 7,5 K/min., 10 K/min., 12,5 K/min., 15 K/min. Values of activation energy and pre – exponential factor Z were calculated with the use of Ozawa-Flynn-Wall method. The time of induction was measured by pressure differential scanning calorimetry (PDSC) under an oxygen pressure of 1400 kPa at temperature of 120 and 140°C. Samples of natural and deodorized cocoa butter were characterized by high oxidative stability and high temperatures of beginning of oxidation process. The value of activation energy for maximum temperature was lower than for onset temperature. The same correctness was observed for pre – exponential factor Z. Deodorized cocoa butter was characterized by a longer time of induction – 114.97 min., than natural cocoa butter – 85.56 min. at temperature 140°C. This demonstrates the greater oxidative stability of deodorized sample. Differences between the results may indicate the effects of the preservation process, that the deodorized fat has undergone. Deodorization process removes the components responsible for the acceleration of oxidation, such as the volatile flavor compounds, low molecular weight fatty acids or metal ions.

Key words: differential scanning calorimetry (DSC), pressure differential scanning calorimetry (PDSC), cocoa butter, oxidative stability.

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Flavoromics in the evaluation of oils quality

Cold pressed oils are appreciated by consumers, among other features, due to their sensory properties. Usually they are characterized by rich aroma, which results from raw material used, as well as technological processes for raw material preparation. Aroma of cold pressed oils consists of many more compounds than aroma of refined ones. In a result, monitoring of their changes in production and storage is much more complex in case of cold pressed oils than in case of refined ones.

For monitoring of volatile compounds in oils gas chromatography has been used, however recent analytical developments in chromatography, including comprehensive gas chromatography (GCxGC) and chemometrics in data treatment provide novel tools for simultaneous tracking of hundreds of volatile compounds.

The term flavoromics can be regarded as a specific field in metabolomics, in which the object of interest is a fraction of volatile compounds that interact with odor receptors. Mentioned above tools are used for profiling volatile compounds, and in conjunction with gas chromatography – olfactometry (GC-O) it is possible to select sensory important key odorants from sometimes hundreds of volatile compounds of cold pressed oils.

This analytical approach will be illustrated with results of analyses of (1) the influence of thermal treatment of argan seeds (*Argania spinosa*, (L.) Skeels) on the profile of aroma and volatile compounds of argan oil, and (2) the influence of technological processes and seeds preparation on the profile of volatile and aroma compounds in cold pressed rapeseed oil.

Key words: flavoromics, volatile compounds, cold pressed oils, rapeseed, argan, GCxGC, chemometrics.

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Ecological and Economic Aspects of Possible Withdrawal of Selected Active Ingredients from Crop Protection Products in Winter Rapeseed Cultivation Technology

The European Union is planning to withdraw a wide range of compounds from the list of active ingredients of crop protection products used in winter rapeseed cultivation. At present the European Commission is searching for a solution to the problem of pesticides disrupting the hormonal equilibrium (EDP – endocrine disruptor pesticides), which may interact with the human hormonal system.

If 8 active ingredients of insecticides, 11 active ingredients of fungicides and 5 active ingredients of herbicides are banned, normal and modern production of rapeseeds will be very difficult.

For example, there are plans to ban thiram, which controls rape seedling blight. In consequence, it will be necessary to increase the standard number of seeds sown and the cost of production will increase. If thiram, neonicotinoids and chloronicotinyls are banned in Poland and other EU countries, there will be no seed treatment products. It will be in disagreement with integrated protection of rapeseed plants.

The new law may also ban 4 active ingredients of the pyrethroid group, which are used in as many as 33 insecticides applied to leaves. As a result, the cost of plant protection will increase 2–4 times per ha, because other chemical groups are more expensive.

If as many as 6 triazoles are banned, the list of fungicides may be shortened by 58 products. In consequence, it will be impossible to guarantee adequate protection of rapeseed plants from diseases. It will also increase the risk of mycotoxins, which are usually carcinogenic substances.

If metconazole is banned, it will be impossible to protect rapeseed plants from fungal diseases during the autumn vegetation and the height of plants will be reduced. This may have negative effect on the wintering of plants.

Weed control will be very difficult, because 83 herbicides may be banned. They contain 5 active ingredients, including glyphosate, which is used to control weeds before and after harvest and before plant emergence.

Rapeseed protection will be very difficult, because it will impossible to control many pests, diseases and weeds.

Apart from the lack of seed treatment products, there will be no insecticides to control cabbage stem flea beetles and turnip sawflies. Also, there will be no fungicides to control cylindrosporiosis. Limitations to the use herbicides will make it impossible to control creeping thistle.

A reduced number of active ingredients will have negative influence on adequate protection, because it will be impossible to rationally apply in alternating manner different groups of chemical products with different mechanisms of action. In consequence, pests will rapidly become resistant to crop protection products.

The greatest changes might concern fungicides if triazoles are banned. The number of fungicides will be reduced 4 times, whereas the number of active ingredients and chemical groups will be reduced nearly by half.

If 24 active ingredients are banned from winter rapeseed protection, it will cause problems to provide adequate integrated plant protection. The cost of plant protection will increase and there will additional problems due to pests' resistance to products. It will be difficult or even impossible to control many pests feeding on rapeseed plants.

According to the expert opinion issued by Kleffmann Group for the Polish Crop Protection Association, the withdrawal of active ingredients will increase the cost of rapeseed protection and production by 26–39%, reduce the yield by 20–50% and deteriorate seed quality by 10–30%.

According to the EU plan, the withdrawal of 75 active ingredients will result in 54 substances being banned in Poland. The plan to ban the use of active ingredients in crop protection products may have been caused by disrupted hormonal equilibrium in mammals, the influence on the environment and pollinators.

Conclusions and results

1. The withdrawal of seed treatment products containing neonicotinoids and thiram and replacing them with leaf treatment applied 2–3 times will increase the cost of autumn protection from 30 zlotys per ha to even as much as 300 zlotys per ha.
2. The withdrawal of metconazole will make it impossible to protect rapeseed plants from fungal diseases during the autumn vegetation and the height of plants will be reduced. This may have negative effect on the wintering of plants.

3. The withdrawal of triazole fungicides will increase the number of treatments with new products, which have a short-term effect and reduced efficacy in controlling major diseases, i.e. white mould and black leg.
4. The withdrawal of fluroxypyr will make it impossible to provide adequate protection from cleavers, which reduces the yield of rapeseeds and causes harvesting difficulties.
5. The withdrawal of glyphosate, which is used as the most important desiccant, will have negative effect on normal one-stage harvest. Substitutes are two times more expensive.
6. The withdrawal of many pyrethroids and other insecticides applied to leaves will increase protection costs and reduce the effectiveness of controlling major pests to rapeseed plants.
7. Worse control of fungal diseases and greater damage caused by pests will increase the risk of mycotoxins, which will deteriorate the rapeseed quality.
8. The withdrawal of many active ingredients will also reduce the number of chemical groups. It will cause difficulties to adequate rotation of treatment products and in consequence, it will accelerate the development of pests resistance to the products applied.
9. The reduction of active ingredients may increase illegal use of crop protection products in winter rapeseed cultivation, which is disagreement with applicable Polish and EU regulations.

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Development of pyrethroid resistance in Czech and Slovak *Meligethes* populations (2009–2015) and correlations between their susceptibilities to lambda-cyhalothrin and chlorpyrifos-ethyl resp. thiacloprid

RESULTS: From 2009 to 2015 susceptibility of *Meligethes aeneus* populations from the Czech Republic (and Slovakia in 2012 and 2015) was tested with lambda-cyhalothrin using IRAC method no. 011. For the last time the highly susceptible populations to the active ingredient were recorded in the Czech Republic (CZ) in 2010 and the last susceptible populations disappeared there in 2013. From 2011 resistant populations began to predominate and in 2015 the frequency of highly resistant populations exceeded the level of 50% in CZ. Slovak (SK) populations seemed to be somewhat less resistant to the pyrethroid compared to the CZ ones. But the resistant populations also predominated there in 2015 and the situation markedly got worse between 2012 and 2015 in SK. Sixty five resp. 60 CZ and SK *Meligethes* populations were tested for their susceptibility both to lambda-cyhalothrin and to chlorpyrifos-ethyl in 2014 resp. 2015 (IRAC method no. 025 was used for chlorpyrifos-ethyl). For each of the tested populations the LC_{50}, LC_{90}, and LC_{95} values for the both insecticides were determined. Correlation analyses were made with

transformed (log10 transformation) LC values. No significant correlation was recorded between the LC_{50} values. Contrary to that, significant ($p < 0.05$) negative (**r** values for negative) correlations with slight or moderate intensity were recorded between the LC_{90} and LC_{95} values (**r** values moved between -0.37 and -0.43). Pyrethroid resistance in *Meligethes* populations indicates their slightly higher susceptibility to chlorpyrifos-ethyl. Eighty six, 68, 60, 65 and 58 CZ and SK *Meligethes* populations were also tested for their susceptibility both to lambda-cyhalothrin and to thiacloprid (BISCAYA 240 OD used) in 2011, 2012, 2013, 2014 and 2015 (IRAC method no. 021 was used BISCAYA 240 OD). For each of the tested populations the LC_{50}, LC_{90}, and LC_{95} values for the both insecticides were determined. Correlation analyses were made with transformed (log10 transformation) LC values. Significant ($p < 0.05$) positive (**r** values for positive) correlation was recorded between the LC_{50} values only in 2014 (**r** = 0.44). Contrary to that, significant positive correlations with rather slight or moderate intensity (**r** values moved between 0.37 and 0.58) were recorded between the LC_{90} and LC_{95} values in three years (2012, 2014, 2015). Pyrethroid resistance in *Meligethes* populations indicates their slightly lower susceptibility to thiacloprid, too.

DISCUSSION: The current level of pyrethroid resistance in CZ *Meligethes* populations has been comparable with the situation in Germany (HEIMBACH & MŰLLER 2013). The situation in SK is somewhat better from the point of view. It is also immediately obvious that lower susceptibility to lambda-cyhalothrin does not mean a predisposition to lower susceptibility to chlorpyrifos-ethyl in *Meligethes* populations. Some other studies also demonstrate that lower susceptibility (or resistance) of pollen beetles to esteric pyrethroids does not increase the risk of lower susceptibility of the pest to chlorpyrifos-ethyl at the same time (PHILIPPOU *et al*. 2011, SLATER *et al*. 2011, ZIMMER & NAUEN 2011, also on: http://www.irac-online.org). And WEGOREK & ZAMOYSKA (2008) described and documented a strong negative cross resistance between pyrethroids and chlorpyrifos-ethyl in pollen beetle populations in Poland (also in WEGOREK *et al*. 2009). On the other hand here presented indications of positive correlations in pollen beetle´s susceptibilities to lambda-cyhalothrin and thiacloprid are in contrast to ZIMMER & NAUEN (2011), who observed no trends of cross-resistance between lambda-cyhalothrin and thiacloprid. In their study even those populations classified as highly resistant to pyrethroids did not show any lower susceptibility to thiacloprid, suggesting the complete lack of cross-resistance.

Key words: *Meligethes aeneus*; pyrethroid resistance; lambda-cyhalothrin; chlorpyrifos-ethyl, thiacloprid, adult vial tests; IRAC.

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Studies of clubroot (*Plasmodiophora brassicae* Wor.) on oilseed rape in the Czech Republic

Clubroot disease, caused by *Plasmodiophora brassicae* (Wor.), has been spreading on winter rape (*Brassica napus* L.) in the Czech Republic over the past five years. Research on *P. brassicae* in the Czech Republic is therefore important for the development of effective strategies to manage clubroot under Czech environmental conditions. Experiments with clubroot resistant cultivars of winter rape were carried out in the field and greenhouse. In the greenhouse, six clubroot resistant cultivars were grown in infested soil collected from various fields in the Czech Republic, and assessed for disease severity. The soil samples also were tested for the presence and amount of *P. brassicae* inoculum by conventional and quantitative PCR analysis. In the field experiment, seven clubroot resistant cultivars were grown and disease development was monitored monthly. Yields were measured at the end of the cropping season. Finally, a set of 17 *P. brassicae* field isolates from across the Czech Republic were assessed for pathotype designation on the differential hosts of Williams, Somé et al., and the European Clubroot Differential set. Collectively, the information obtained on the effectiveness of host resistance and pathogenic diversity of *P. brassicae* populations from the Czech Republic may help to more effectively manage clubroot in this country.

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Investigation of metabolome *Brassica napus L. mutants* after primary infection by phytoplasmas like organism

Pathogenic bacteria causing the phytoplasmas diseases annually contribute to reduce seed yield of winter oilseed rape. Identification in the field infected plants is not difficult, because the infested plants have a characteristic shaggy appearance and often grow over field. Moreover, such plants have no flowers correctly developed, the lack of normal styles

and deformed, discolored petals. Quite often in such plants in the lower part of the stem can be observed properly developed inflorescence and flowers, and then the normal pods and seeds. Previous studies have shown that approx. 30% of the seed (the embryos) from infected plants by phytoplasmas is permanently mutated, striped. Similarly, plants infected by phytoplasmas and striped plants also in the lower parts of the stems produce normally developed flowers and inflorescences.

In the field of PB Strzelce Ltd., Co. IHAR Group Division at Malyszyn, during the growing seasons 2014 and 2015 observations of distortion oilseed rape caused by phytoplasmas and mutant plants were carried out. A small percentage of infected plants and mutants of rape were recorded during observation in the conditions of production fields on the surface approx. 1500 m^2. Only 1–2 plants were observed with typical signs of the phytoplasmas diseases and the same number of striped plants. This result pointed to a small threat from pathogenic bacteria. Serious threats to oilseed rape are mutants and their pollen, which is able to pollinate properly developing plants and contributes to the emergence mutants in the first generation. In two years the metabolome of deformed and mutated plants of *B. napus* were studied. Stripped plants were used for analysis (described above). On them, it was possible to distinguish two types of stems: strong stripped and normal. Each of these plants produced normally developed flowers in contrast to plants infected by phytoplasmas. Experiments were performed using spectroscope (FTIR far-infrared Fourier transform) in the range of wave number between 4000–400 cm^{-1}. After tests, differences in the metabolome of specific regions of proteins, lipids and polysaccharides were reported. Identical results were obtained in previous years.

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The influence of storage on the volatile profile composition of cold pressed oils obtained from gold and brown seeds using GCxGC and GC-HRT

Seed quality is a crucial factor for cold pressed oil production. Depending on the plant variety used, related usually with differences in chemical composition (both fatty acid profile and other constituents), one may obtain virgin oils differing with regard to their sensory properties and oxidative stability.

The aim of the study was to study the changes that take place during the storage of cold pressed oil obtained from gold (GFO) and brown (BFO) flaxseeds at 60°C for 0, 2, 4, 7 and 10 days. The samples were analysed for basic measurements such as peroxide value, total polyphenol content and radical scavenging activity. Fatty acid composition of the oils was also determined. For volatile compounds' isolation, solid phase microextraction (SPME) was used. The samples were analysed by means of high resolution Time-of-Flight mass spectrometer (GC-HRT) and two-dimensional gas chromatography – mass spectrometry (GCxGC-ToFMS).

The analysed oils varied with regard to their fatty acid composition, especially with regard to oleic and linoleic acid percentage (GFO – 13.3 and 60.5%, BFO – 22.1 and 52.3%). Fresh BFO, in comparison with GFO, had lower radical scavenging activity

(ZLO – 26.64%AA, BLO – 21.41%AA). The results obtained from chromatographic analyses were analysed using multivariate statistical analysis. Principal component analysis made it possible to differentiate between the two varieties of cold pressed oils and to identify the compounds characteristic for fresh and oxidised oils.

Key words: flavoromics, volatile compounds, virgin oil, flaxseed, storage, chemometrics, multivariate analysis, GCxGC, GCHRT.

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Oilseed cakes as source of antioxidants

Oilseed cakes are by-products of oilseeds pressing and they are rich in proteins, carbohydrates, mineral compounds, fiber and some lipids. They are normally used for feed applications to poultry, fish and in swine industry or as a fuel in heating plants. Recently, an attempt to support various biotechnological processes with oilseed residues is considered. From an economical point of view oilseed cakes seem to be overlooked as they show potential for applications as nutraceuticals and functional food ingredients which would be consistent with recent trends on the food market searching for products containing bioactive substances, especially antioxidants, omega-3 fatty acids and dietary fiber.

Therefore, the present research focuses on the antioxidant potential of flaxseed (Oliwin and Szafir variety), evening primrose and black cumin cakes received after oil cold-pressing. The aim of the study was to measure the total phenolic content (TPC) and antioxidant activity of ethanolic oilseed cake extracts with use of DPPH radical scavenging activity method and reducing power (FRAP) assay. Moreover, the efficiency of added extracts in enhancing the oxidative stability of cold-pressed flaxseed oil incubated at elevated temperature was also assessed.

The extracts from defatted oilseed cakes showed relatively high total phenolic content and the antioxidant activity in model assays. The highest TPC and antioxidant potential exhibited extract obtained from evening primrose cake.

The addition of extracts to the flaxseed oil delayed the oxidative changes in selected cases and was dependent on the concentration used. The highest protective efficiency towards flaxseed oil exhibited Oliwin var. flaxseed cake extract. Therefore, the flaxseed cake extract might be used as an alternative natural source of antioxidants for inhibition of flaxseed oil oxidation.

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The quality of exotic cold pressed oils

Cold pressed oils plays a role of functional food. The presence of bioactive compounds influence human health, and could protect them from different diseases. Nowadays, quality together with safety and authenticity is a main factor in the food products evaluation, and advanced analytical techniques should be the elementary tool in a control process.

The aim of the study was to evaluate the quality and potential stability of exotic cold pressed oils. Different exotic cold pressed oils were investigated for their fatty acids composition, peroxide value, acid value and color. All analyzed samples revealed a good quality. Peroxide value in cold pressed oils samples were between 0.7–5.8 mEq O_2/kg of oil, whereas the acid value expressed as mg KOH/g of oil was in the range from 0.3 to 4.7. In all analyzed samples the predominant fatty acids were unsaturated. Therefore, on the basis of fatty acids composition, the oxidizability values (COX) were calculated as indicator of potential oil stability.

Key words: cold pressed oils, quality, gas chromatography, COX.

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Rapeseed oil as a source of unsaturated fatty acids in human milk fat substitutes obtained by the interesterification process

According to the World Health Organization, breast milk is the ideal food for babies. One of the main components of human milk is fat, which is an extremely valuable source of nutrients needed for growth and development of infants and young children. Natural breast-feeding is not always possible, therefore, to satisfy the nutritional needs of infants many mothers use of modified milk formulas. Commercially available infant formulas contain fat similar in its structure to the human milk fat. Human milk fat is unique due to the structure of triacylglycerols (TAG). This fat is characterized by a high content of saturated palmitic acid (approx. 20–30%), which is located primarily in the internal position of TAG. This structure of TAG influences the proper absorption of fatty acids from the food, and it does not cause loss of calcium. The human milk fat contains also fatty acids from the omega-3 and omega-6 which are very important for the development of infants and young children. Lard is one of the animal fat characterized by a similar distribution of fatty acids in the TAG molecules to the human milk fat, but does not contain sufficient amounts of unsaturated fatty acids. One of the methods to increase the proportion of unsaturated fatty acids in the TAG of animal fats is their enzymatic interesterification with vegetable oils. The result are modified fats of the desired properties, the planned fatty acids composition and their distribution in TAG.

The aim of the study was to characterize human milk fat substitutes obtained from the mixture of lard and rapeseed oil interesterified in the presence of the enzyme preparation Lipozyme RM IM. The mixture of fat, wherein the weight ratio of fat to rapeseed oil was 8:2 was the subject of the research. Interesterification reaction was carried out at 60°C for 4, 8 and 24 hours. In the raw materials and in the products of interesterification the acid value, the peroxide value and the composition of fatty acids and their distribution between the internal and external positions of the TAG were determined. Oxidative stability was also determined by pressure differential scanning calorimetry (PDSC).

The interesterification caused an increase in the peroxide value and in the acid value of all interesterified products in relation to the starting materials. The results of accelerated oxidation test PDSC also indicated a reduced resistance of modified products to oxidation.

The use of enzymatic interesterification of a mixture of lard, rapeseed oil, however, allows to obtain a product similar in terms of composition and distribution of fatty acids in TAG molecules to the human milk fat.

Key words: human milk fat substitutes, rapeseed oil, lard, enzymatic interesterification.

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Bioactive phospholipids present in foods and products of their hydrolysis as preventive factors in civilization diseases

The results of numerous epidemiological studies indicate that phospholipids present in foods play an important role in the prevention of chronic diseases, which entrance cardiovascular disorders, neurological and autoimmune diseases, as well as cancer.

In the lipid bilayer, forming cellular membranes native phospholipids are responsible for the maintenance of appropriate fluidity and permeability of cell membranes, which in turn affects the activity of membrane proteins, especially receptors and consequently on the proper functioning of cells. Phospholipids due to their chemical structure act as an accessible source of biologically active fatty acids, including the essential fatty acids. Furthermore, in their structure the presence of furan fatty acids were detected, which play an important role in prevention of atherosclerosis. Products of endogenous hydrolysis of phospholipids also exhibit biological activity. These products such as lysophospholipids formed as a result of liberation of free fatty acid from glycerophospholipids in the reaction catalyzed by phospholipase A, as well as phosphatidic acid and hydrophilic subunits released by the activity of phospholipase D, also display a number of physiological activities. Bioactive products of hydrolysis also include ceramides liberated from phosphosphingolipids after removal of a hydrophilic unit catalyzed by sphingomyelinase.

Phospholipids are supplied to the human body with food eaten each day. A high content of phospholipids is present in egg yolk, and rapeseed or soybean lecithin obtained by degumming of crude oil. Particulary important are health-promoting phospholipids derived from seafood, because of the high content of essential fatty acids of the n-3 family.

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GENETICS AND BREEDING

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Genotype by environment interaction for seed yield in winter oilseed rape (*Brassica napus* L.) using additive main effects and multiplicative interaction model

The objective of this study was to assess genotype by environment interaction for seed yield in rapeseed cultivars grown in West Poland by the additive main effects and multiplicative interaction model. The study comprised 25 winter rapeseed genotypes (15 F_1 CMS *ogura* hybrids, their parental lines and two varieties: open pollinated Californium and hybrid Hercules F_1), analyzed in five localities through field trials arranged in a randomized complete block design, with four replicates. Seed yield of the tested genotypes varied from 15.9 to 80.99 dt/ha throughout the five environments/localities, with an average of 39.69 dt/ha. In the variance analysis, 69.82% of the total yield variation was explained by environment, 13.67% by differences between genotypes, and 8.15% by genotype by environment interaction. Seed yield is highly influenced by environmental factors. Due to high influence of the environment on yield high adaptability of the genome is required.

Key words: adaptability, biplot, *Brassica napus*, seed yield, stability.

2. Agnieszka Dobrzycka[1], Joanna Wolko[1], Jan Bocianowski[2], Kamila Nowosad[3]
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Phenotypic variation of yield related traits in DH lines and hybrids of winter oilseed rape (*Brassica napus* L.)

Oilseed rape breeding programs are mainly focused on obtaining varieties with high seed yield, which is associated with increased consumption of vegetable oils and the use of rapeseed for biofuel production. Improved productivity is obtained, inter alia, by F_1 heterotic hybrids, in which the effect of heterosis occurs.

The experiment was designed to investigate variation of DH lines and two populations of hybrids. Plant material used in the project includes 182 objects: 60 DH lines, 60 single cross hybrids (CMS×DH), 60 three-way cross hybrids (CMS/DH×*Rfo*), and CMS and *Rfo* lines, selected for the large genetic distance with respect to the DH lines. DH lines were derived from F_1 hybrid between a line with high oil content and the line with high seed yield. Single cross hybrids were obtained from crossing the CMS *ogura* line with DH lines,

and three-way cross hybrids – from crossing of obtained single cross hybrids with *Rfo* restoring line. Field experiments are placed in Borowo (Plant Breeding Strzelce Ltd.), have a randomized blocks design with three replications and include two growing seasons: 2014/15 and 2015/16. Traits evaluated in the field are: flowering length, plant height, branches per plant, siliques per plant, silique length, seeds per silique, thousand seed weight, and oil content in seeds. On the collected results the analysis of variance were performed and correlations between the studied traits were examined. These analyzes were conducted considering groups of objects to observe differences in the variability of studied traits between the groups.

In the poster results of the first year of observations are presented. For individual groups of objects, an analysis of variation was performed and shown graphically on the box plot diagrams. Analysis of variance showed statistically significant differences between groups for all eight of the observed traits. Flowering time was the longest in the group of CMS×DH hybrids, and the shortest in the *Rfo* plants. The CMS/DH×*Rfo* hybrids were characterized by the largest plant height, and the lowest height had *Rfo* restoring line, which also had the largest number of branches and siliques per plant. This line achieves, however, the lowest values for traits such as length of siliques, number of seeds per silique and thousand seeds weight. The highest thousand seeds weight were observed in the group of CMS×DH hybrids and in the CMS *ogura* line. The lowest oil content in the seeds were observed in the group of DH lines, and the highest – in the CMS/DH×*Rfo* hybrids and CMS *ogura* line.

3. Galina Mozgova, Valiantsina Lemesh, Jadwiga Piliuk
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PCR assay of oilseed rape varieties for development of F1 hybrids based on CMS *ogura*

A molecular genetic analysis of 51 varieties of oilseed rape for the genes determining edible oil quality (*FAE1.1*., *Fad3A* and *Fad3C*) and for the cytoplasmic male sterility (CMS) system *ogura* genes to select promising varieties and their use in breeding of highly heterotic hybrids based on CMS has been carried out.

As a result of investigations it was revealed that all genotypes analyzed were homozygous for the recessive allele of *FAE1.1* gene, i.e., exhibit reduced synthesis of erucic acid in the seed oil. Individual plants that were hetero- and homozygous for the recessive alleles of *Fad3A* and *Fad3C* genes were identified and therefore showed reduced level of linolenic acid synthesis in the seeds and reduced oil oxidation speed.

Using 51 varieties of oilseed rape a comparison of different genetic markers for CMS *ogura* fertility restorer *Rfo* gene was carried out to test the efficiency of these markers for *Rfo* gene identification. The optimization of PCR conditions to identify *ogura* male sterile cytoplasm at 12 CMS lines has been carried out.

The biochemical evaluation of seed composition in spring and winter oilseed rape varieties, selected with DNA markers, showed that the lowest linolenic acid content was observed in 4 varieties of oilseed rape. It was confirmed by molecular-genetic analysis as these forms were homozygous for the recessive allele of *FAD3C* gene and heterozygous for the *FAD3A* gene. According to biochemical analysis of fatty acid composition there

was no erucic acid in seeds of all varieties investigated which was confirmed with PCR analysis.

As a result, 27 promising forms were selected on the basis of molecular-genetic and biochemical analyses and were used for the creation of 58 fertile hybrids F1.

4. Tomasz Szymański, Michał Rokicki
Poznańska Hodowla Roślin Spółka z o.o.
Response of various types of winter oilseed rape to different weather conditions based on a research conducted at Poznańska Hodowla Roslin Sp. z o.o., plant breeding station Wiatrowo

The basis of the investigations was field experiments carried out at Poznańska Hodowla Roślin Sp. z o.o. plant breeding station in Wiatrowo (N 52°45′ E 17°08′) in years 2013/2014 – 2014/2015. The experiments were conducted in a split – plot design. We investigated the effect of weather conditions on yield and quality of restored hybrids of oilseed rape and doubled haploids. Thermal conditions in the analyzed periods were very similar, only the months of January in 2014 and 2015 showed a significant difference in temperature. We observed a large discrepancy in precipitation on average 23.25 mm per month. It was very important, especially during the sowing – difference of rainfall 19.8 mm and spring vegetation – difference of precipitation of 90 mm. In a very important way it influenced for restored hybrids of oilseed rape and doubled haploid yields. Higher rain precipitation also resulted in the extension of length of flowering period, which led to bigger crop yield in the season 2013/2014. Large differences in the interaction between environment and level of fat content in doubled haploids seeds where observed. Restored hybrid show no impact of climatic conditions on the percentage of oil content seeds in both growing seasons.

5. Stanisław Spasibionek, Teresa Piętka, Krystyna Krótka, Jan Krzymański
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The possibilities for further reducing the glucosinolate contents in seeds of double low rapeseed (*Brassica napus* L.)

Oilseed rape recombinant breeding and selection over the past half-century resulted in a great progress with respect to seed yield and quality, thus making this oil crop the most important one in Poland and leading in the world. Rapeseed was stripped of two features that lower the economic value of traditional varieties, and it was achieved by many years of breeding with the use of natural genetic variability without the use of genetic modification (GMO). Erucic acid (C22: 1) was eliminated from fatty acid composition of seed oil due to its unfavourable nutritional value. Similarily, glucosinolates content was significantly reduced in seed meal, as they cause disorder of iodine metabolism in the animal body. The content of alkenyl glucosinolates, and especially the most harmful progoitrin was reduced significantly in double low cultivars. At the same time, the level of desirable indol glucosinolates was retained, for prevention of cancer diseases. Seeds with reduced glucosinolates level can be used as a valuable high-protein fodder. The Polish Standard for double low oilseed rape was established on the basis of numerous results obtained

by Polish researches on feeding animal with feed containing double low rapeseed meal or cake. The standard for glucosinolate content at 15 micromoles per gram of seed (about 0.4%) is the lowest one in the world (Polish Standard PN-90/R-66151 and PN-EN ISO 9167-1:1999). It concerns the total of alkenyl and indol glucosinolate content. Nevertheless, its further lowering is still a challenge in rapessed breeding. Glucosinolate content according Polish Standard provides good weight gain and reproduction of animals, but continues to cause enlarging of the thyroid. Further breeding towards reducing the glucosinolate content in the seeds needs to be continued to promote such rapeseed meal as competitive for soybean meal.

The aim of the presented research was to select double low winter oilseed rape lines with extremely low alkenyl glucosinolates content, less than 5 $\mu M \cdot g^{-1}$ seeds, from population comprising double low winter oilseed rape lines with high oleic acid content (C18:1, ≥75%) in seed oil.

The plant material contained 23 inbred lines from two research programs at IHAR – PIB Poznan. The first group of 16 lines comprised genotypes characterized by high oleic acid content, more than 80%, and lowered linoleic and linolenic acid content, (to 6% of each), selected from 165 recombinants of M10453 and M10464 high oleic mutants and breeding lines and population-varieties of high agricultural value. The second group of 7 lines originated from recombinant breeding using natural variability. The lines were obtained from 37 forms using recurrent recombinant breeding. The selected lines were characterized by very low of glucosinolate content (less than 5μM g^{-1} seed) and increased oleic acid content (over 70%).

Lines were evaluated in a field experiment in the growing season 2013/2014 comparing them two control varieties Monolith and Chagall. Analysis of variance showed that seed yield significantly differentiated the tested genotypes. It has been shown that the line type HO PN1-2006 (48.68 $dt \cdot ha^{-1}$) yielded above the control varieties Monolit (47.11 $dt \cdot ha^{-1}$), and Chagall (43.57 $dt \cdot ha^{-1}$). Two lines PN19-256 (44,51 $dt \cdot ha^{-1}$), PN17-246 (44.22 $dt \cdot ha^{-1}$) with low glucosinolate content yielded above standard variety Chagall (43.57 $dt \cdot ha^{-1}$). Six lines in terms of fat content (46,63–49,05%) outperformed reference varieties Chagall and Monolit (average of 46.52%). The high significance of the diversity of genotypes in terms of the composition of fatty acids in seed oil was stated. Tested lines of HO type maintained a significantly high oleic acid content in the range: 73,20–77,93%. High significance in terms of the genotypes diversity in total of glucosinolates and total of alkenyl glucosinolates was also found. Seven lines were characterized by a desired significantly lower total glucosinolates (5.59 $\mu M \cdot g^{-1}$ seed – 8.18 $\mu M \cdot g^{-1}$ seed) and total of alkenyl glucosinolates (1.88 $\mu M \cdot g^{-1}$ seed – 3.25 $\mu M \cdot g^{-1}$ seed) as compare to the control varieties Chagall (13.65 $\mu M \cdot g^{-1}$ seed, 9.10 $\mu M \cdot g^{-1}$ seed) and Monolit (10.83 $\mu M \cdot g^{-1}$ seed, 6.45 $\mu M \cdot g^{-1}$ seed).

Obtained breeding lines with high oleic acid content and lines with reduced glucosinolate content in seeds reached the yielding level similar to the current population varieties. Differences in fatty acid and glucosinolate contents in seeds of these lines are no longer correlated with seed yield and weight of 1000 seed. Further lowering of glucosinolate content and differentiation of fatty acids content should not adversely affect the yielding of next breeding lines.

Significantly negative correlation between oil content in the seed and total of alkenyl glucosinolate content provides opportunitiy to continue the decrease of glucosinolate content without adversely affecting the oil content in the seeds of new genotypes.

Lack of correlation between of glucosinolate content in the seeds and of polyunsaturated fatty acids contents (oleic, linoleic, linolenic) indicates that it should not be difficulties in breeding work for change of both groups of compounds.

Highly statistically significant negative correlation between oleic acid content and linoleic and linolenic acids contents was observed. This dependency can be used in further work on even bigger differentiation of fatty acid composition of rapeseed oil. Applied methods of recombinant breeding using natural variability and chemical mutagenesis though laborious and lengthy but have proved to be effective.

Line PN1514 (HO type) from group I was in 2013 accepted for evaluation in field trials by COBORU. In 2016 this line was entered to the National Register of COBORU under the name of Polka. It is first in Poland variety of the HO type - with a high oleic acid content (79.4%) and reduced linoleic (6.9%) and linolenic acid content (7.2%). Changed 18-carbon fatty acid composition, increased fat content (to 47.1%), high protein content (40.3% defated matter) and low glucosinolate content (11.9 $\mu M \cdot g^{-1}$ seeds) makes that Polka is an interesting raw material for fats and fodder industry. It has also high dietary value due to the low saturated fatty acids content (5%) and desired ratio of linoleic to linolenic acid (omega-6/omega-3) — 1:1.

Lines from the group II are characterized by three times lower and stable alkenyl glucosinolate content and can be used in breeding work on further lowering of these compounds in double low rapeseed.

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Analysis of fatty acids composition in *Brassica* interspecific hybrids seeds

Rapeseed (*Brassica napus* L.) with Canola quality, i.e. low-glucosinolate, low-erucic varieties, nowadays represent one of the major sources of vegetable and edible oil with a low content of saturated fatty acids (5–7%) and a high content of polyunsaturated fatty acids. The value of rapeseed for food and feed uses can be further improved by increasing desirable traits, e.g. oil content, and reducing undesired characteristic, e.g. fiber content and anti-nutritional compounds. Plant breeding work with rapeseed, aimed at improving seed quality is at present directed towards improving the oil through alteration of the fatty acids composition. The improvement of seed quality is one of the most important objectives in *Brassica* breeding for satisfying future edible oil requirements. The functional and nutritional values of different vegetable oils are dependent on the nature of the different fatty acids, which are incorporated into the oil (triacylglycerols). For the development of varieties with the desired characteristic of low linolenic acid and high linoleic acid in the seed oil, different breeding strategies have been made including interspecific hybridization. The aim of our study was to determine whether the interspecific crossing can help to increase the range of fatty acids variability in *Brassica* hybrid seeds and consequently

enable the production of edible oils with improved fatty acid composition. Seeds of F_6 generation of interspecific hybrids between *B. napus* and *B. carinata*, *B. juncea* and *B. rapa* ssp. *pekinensis* as well as parental genotypes of *Brassica* species i.e.: *B. napus*, *B. carinata*, *B. juncea*, *B. rapa* ssp. *pekinensis* were harvested and the fatty acid composition of the seed oil was analyzed by gas chromatography (GS). Among all genotypes significant variability in fatty acids content were observed. The content of oleic acid (C18:1) ranged from 38.8 to 57.85%, linoleic acid (C18:2) from 15.34 to 17.85%, linolenic acid (C18:3) from 7.8 to 9.29% and erucic acid (22:1) from 0.84 to 4.17% respectively. The medium values of fatty acids were observed every time for hybrids obtained from crosses with *B. rapa* ssp. *pekinensis*. The wide variability observed for all the fatty acids may allow for the edible oil production with consumer needs reflection.

7. Kamila Nowosad[1], Henryk Bujak[1], Andrzej Kotecki[1], Jan Szopa-Skórowski[2]
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Genetic variability in flax breeding material based on microsatellite markers

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Morphological variability of flax cultivars (*Linum usitatissimum* L.) of different geographical origin

Flax (*Linum usitatissimum* L) is a valuable resource for various industries, as it is commonly used in the pharmacy, in production of food, textile and cosmetics. Flaxseed, in the form of cleaned seeds or tablets, has a protective effect on the stomach and improves peristalsis. Linseed oil, which primarily includes unsaturated omega-3 fatty acids, lowers level of "bad" LDL cholesterol and reduces the risk of cardiovascular diseases. As used in the Dr. Budwig's diet it helps to combat diabetes, multiple sclerosis, or even cancers. With its long fibers fabric flax is produced, as well as sticking plasters speeding up wound healing and analgesic, due to the presence of cannabidiol. In the cosmetics industry flax is used for the production of shampoo (antidandruff agent and a hair tonic), soaps, creams or masks. It also applies to the manufacture of paints, lacquers, varnish, linoleum, particle boards or high-quality paper, and the linseed cake is processed for animal feed.

Five cultivars of *L. usitatissimum* were investigated. They differed origin – each one was grown up on another continent: Three fibrous cultivars came from Ukraine, Japan, and Egypt and two oily cultivars were from Canada and Argentina. The study was conducted on the flax flowers received from the collection of the Experimental Institute of Natural Fibres and Medicinal Plants in Pętkowo (Poland). The anthers were isolated and were subjected to acetolysis. Thus obtained pollen grains were used for further studies. For 30 pollen grains of each cultivar the biometry was done in LM. The length of polar (P) and equatorial (E) axes, exine thickness, width of mesocolpium and diameter of apocolpium were measured and P/E ratio was determined. The pollen grains were also observed in SEM and series

of microphotographs, illustrated pollen morphology, were taken. The aim of the study was to determine the variation in pollen morphology among the flax cultivars of different geographical origin.

The pollen grains of analyzed flax cultivars were characterized by a similar morphology. All grains were of medium size, symmetrical, with a circular amb, trizonocolpate. Grains were semitectate. The exine sculpture was formed by processes with strongly flattened apexes. The tops were partially fused together in irregular groups, separated by grooves of variable shapes. With LM gemmate sculpture was visible, with SEM – fossulate type of ornamentation.

A type of flax cultivar had no significant effect on the size of pollen grains. On average, the largest grains (length of P and E axes) were noted in the Canadian flax, and the smallest in the South American flax. Oily cultivars were only marked out by thicker exine. The widest mesocolpium was observed in the fibrous African cultivar, and the largest diameter of apocolpium in the oily Canadian cultivar. The variability of the studied traits was always small. It ranged from 2.13% (P/E in Japan cultivar) to 15.66% (width of mesocolpium in Ukrainian cultivar).

9. Magdalena Walkowiak[1], Grażyna Silska[2], Krzysztof Michalski[1], Marcin Praczyk[2]
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Characterization of a collection of linseed (*Linum usitatissimum* L.) with varying fat content and composition of fatty acids in seed oil

The aim of studies undertaken by the Plant Breeding and Acclimatization Institute – National Research Institute (IHAR – PIB), and the Institute of Natural Fibres and Medicinal Plants in Poznań, was to assess the content of fat and the composition of fatty acids in the collection of linseed (*Linum usitatissimum* L.) varieties and lines. Linseed genotypes originating in different climate zones were also evaluated with regard to parameters including seed yield per ha, thousand seed weight and seed colour.

Assays to determine the content of fat and the composition of fatty acids in linseed oil were performed at the IHAR – PIB Biochemical Laboratory in Poznań. The fat content was determined by infrared analysis (calibration performed on the basis of a seed sample at IHAR – PIB in Poznań) by means of a NIRS 6500 spectrophotometer with a reflection detector within the range of 400–2500 nm. The composition of fatty acids was determined by means of a method proposed by Byczyńska and Krzymański (1969), based on gas chromatography of methyl esters of fatty acids contained in linseed oil.

Linseed oil contains five fatty acids: palmitic, stearic, oleic, linoleic and linolenic. Palmitic ($C_{16:0}$) and stearic ($C_{18:0}$) acids belong to the group of saturated fatty acids found in plant-derived oils. Oleic acid ($C_{18:1}$) is a monounsaturated fatty acid. Linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) acids are classified as essential polyunsaturated fatty acids. Linoleic acid ($C_{18:2}$) is a diunsaturated, and linolenic ($C_{18:3}$) – a triunsaturated acid. In view of the fact that mammalian cells are unable to synthesize these acids, they must be continually supplied in the daily diet. Diets that are rich in essential polyunsaturated fatty acids protect the human body from a number of diseases. From the consumer's point of view, linolenic is the most important acid, as it is present in large quantities in only two oil types: linseed

oil and rapeseed oil. Thanks to its high content of linolenic acid linseed oil exhibits significant antioxidant properties. However, linseed oil with a content of polyunsaturated fatty acids exceeding 50% has a higher level of instability and a shorter period of suitability for consumption. Consequently, when mutation breeding became available, linseed genotypes were developed with a view to yielding more stable oil with an increased content of linolenic acid, also suitable for frying and cooking. The first low-linolenic linseed variety was registered in Canada in 1993.

Based on results obtained in studies carried out by the two research centres, linseed cultivars and lines can be divided into genotypes associated with high and low content of linolenic acid in seed oil.

10. Marcin Praczyk, Grażyna Silska
Institute of Natural Fibres and Medicinal Plants in Poznan
Preliminary results of new flax varieties breeding with high fiber and seed yield to increase the profitability of cultivation

Obtainment of new flax varieties in the combination of high yield of seeds an fibre in one genotype is the aim of presented study. Cultivation of this type varieties (dual purpose varieties) combined with the innovative harvesting and plant processing application is more profitable than traditional linseed or fiber flax varieties. The results of selected F_1 and F_2 hybrids, as well as 3/59/10 breeding bred, in terms of plant height, straw yield, seed yield and 1000 seeds weight, compared to the parental forms and traditional linseed and fiber flax varieties were presented. The investigations were carried out at experimental farms of Institute of Natural Fibres and Medicinal Plants in Pętkowo (wielkopolskie district) and Wojciechów (opolskie district). The results shows diverse phenotypic effect in hybrids obtained by crossing between linseed and fiber flax genotypes, as well as high usefulness of the methods used for breeding of dual purpose flax varieties. In several hybrids managed to get a yield of straw and seeds at a sufficiently high level. These genotypes may be material to the registration of new varieties after genetic stabilization.

Key words: flax, dual purpose varieties, breeding, profitability of crops.

11. Magdalena Walkowiak, Krzysztof Michalski, Krystyna Krótka
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
High-morphine lines of oilseed poppy (*Papaver somniferum* L.)

Poppy cultivation in Poland is subject to the Act of 29 July 2005 on Counteracting Drug Addiction (Polish Journal of Laws 179, item 1485, as amended). According to legal categories, low-morphine poppy refers to "a plant from the opium poppy species belonging to a variety in which the content of morphine in a single seed pod (poppy head) without seeds, together with the adjoining stem with a length of up to 7 cm, is below 0.06%, expressed as the dry weight of the above-mentioned plant parts". Under the law in place, poppy cultivation in Poland is approved only on a strictly defined area, in designated

regions, in strict compliance with a relevant licence issued on an annual basis by applicable public administration bodies.

The aim of the reported study was to evaluate the content of morphine in dry seed pods of high-morphine opium poppy lines selected from the collection belonging to the Department of Genetics and Breeding of Oilseed Crops, Plant Breeding and Acclimatization Institute – National Research Institute (IHAR – PIB).

The study material consisted of 16 poppy lines obtained by crossing different forms of high-morphine poppy and two poppy varieties: Lazur and Morfeusz. The genotypes under study were sown in four replicates, on plots with a total area of 0.9 m^2, in a one-year field trial.

During the vegetation period, the plant greenness index in SPAD units was determined using a Hydro N-Tester (Minolta 502). The height of plants was measured and the number of branches per plant was calculated. Following the harvest, the seed and seed pod yield was assessed.

Based on the method of colorimetric analysis developed at the Plant Breeding and Acclimatization Institute – National Research Institute (IHAR – PIB), a chemical assay was performed to determine the content of morphine in the seed pods harvested from the plants' main stems.

All the genotypes under study were shown to have a high content of morphine. Further breeding efforts will make it possible to develop morphine-rich poppy varieties with a high addictive potential, but excellent as a pharmaceutical starting material for the manufacture of analgesics.

BIOTECHNOLOGY

12. Katarzyna Lechowska[1], Szymon Kubala[2], Łukasz Wojtyla[1], Muriel Quinet[3], Stanley Lutts[3], Małgorzata Garnczarska[1]
[1] Adam Mickiewicz University in Poznan, Department of Plant Physiology
[2] Institute of Biochemistry and Biophysics Polish Academy of Sciences in Warszawa, Department of Protein Biosynthesis
[3] Groupe de Recherche en Physiologie Végétale (GRPV), Earth and Life Institute – Agronomy (ELI-A), Université catholique de Louvain, Belgium
Water status in primed rape seeds during germination – NMR, SEM analysis and expression of aquaporins

The effectiveness of the seed priming may be influenced by the rate of water uptake and hydration state of germinating seed, which trigger the activation of metabolism. Higher uptake of water was observed in primed seeds up to 12 h of germination. Changes in water status were examined by NMR spectroscopy; analysis of T_2 relaxation times revealed the presence of a four-component water proton system in rape seeds, each with a different magnetic environment. The intensities of two of them are predominant – the first one (the shortest T_2 – 3 ms) is connected with bound water and the second one (~100 ms for dry seeds) is attributed to oil component. It is evident that during hydration of primed seeds the most significant changes in terms of its contribution in molecular dynamics occurred for the population of bound water. This indicates that immobilization of water molecules by macromolecules becomes less efficient during imbibition of primed seeds. Kinetic of water uptake and changes in relaxation times are reflected in loosely packed embryo in primed seeds and structural changes of the seed coat surface visualized by SEM. Molecular analyses point out a pivotal role of aquaporins in the water uptake during the priming process and the germination of primed seed.

Project was funded by National Science Centre grant no. 2011/03/B/NZ9/00068.

13. Anna Grygier, Magdalena Rudzińska
Poznan University of Life Sciences, Department of Food Chemistry and Instrumental
Microorganisms in polyunsaturated fatty acids production

The appropriate level of polyunsaturated fatty acids is important in the prevention of heart diseases, cardiovascular diseases, cancer and can help to react against inflammations. However, our body is not capable of producing polyunsaturated fatty acids which is why we need to take care of delivering the right amount of these compounds along with food. Due to the very small amount of fish and vegetable oils consumption which, so far, are the major sources of polyunsaturated fatty acids, there is still ongoing search for new sources of the above acids.

Microorganisms can be significant polyunsaturated fatty acids' source. Microalgae and fungi can be ranked high in the group of substances with the greatest potential for PUFAs production. From micro-algae, such as Schizochytrium, Thraustochytrium, and Ulkenia edible oil is produced. It has a high content of natural antioxidants (carotenoids, tocopherols), which counteract the adverse oxidative processes. Additional advantage of using microalgae is high fat performance, even 71% of the biomass of microorganisms.

For many years fungi Mortierella, Zygomycetes, Aspergillus, Trichoderma and Mucor genera have been tested as cells with a high ability to accumulate lipid. However, there are some studies available showing that fungi produce oil with higher content of α-linolenic acid than microalgae.

In recent years mould of the genus *Galactomyces geotrichum*, that was isolated from fried cheese, has attracted more attention. By optimizing production through modifying the culture medium the production of n-3 was increased tenfold.

All these microorganisms are subjected to further various experiments in order to increase the production of polyunsaturated fatty acids either by molecular genetics or by changing the culture conditions or the culture medium components.

Due to their capacity for the production of polyunsaturated fatty acids microorganisms that are safe for humans might be used for the production of pharmaceutical preparations or food additives in order to obtain functional foods.

14. Agnieszka Dobrzycka[1], Joanna Wolko[1], Katarzyna Gacek[1], Philipp E. Bayer[2]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
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Genome-Wide Association Study (GWAS) to identify markers for oil, protein and fibre content in winter oilseed rape (*Brassica napus* L.) seeds

Winter oilseed rape (*Brassica napus* L.) is the most important oilseed crop in Poland. The quality value of *B. napus* seeds is determined, inter alia, by the fat (40–50%), protein (over 20%) and fibre (13–28%) content, e.g. for feed industry improving protein content and its digestibility is of great interest. Discovering genes regulating these complex seed quality traits would be a great resource for marker assisted selection in oilseed rape breeding in future. Here, we applied genome-wide association study (GWAS) which enables identification of genes associated with a trait of interest. Two parental and 60 doubled haploid (DH) lines were analysed for oil, protein and fibre content in seeds using near infrared spectroscopy (NIR). We attempted to associate variability of these traits with 90 205 single nucleotide polymorphisms (SNPs) (Illumina® HiSeq) using GAPIT software. Physical location of SNPs from the GWAS analysis is presented across the chromosomes of *B. napus*. Described research approach is an innovative tool in oilseed rape genomic studies.

AGRONOMY

15. Władysław Malarz, Marcin Kozak, Andrzej Kotecki
Wrocław University of Environmental and Life Sciences, Department of Crop Production

The effect of TS biostimulators on morphological features and yield of winter rape

The Department of Crop Production of the Wrocław University of Environmental and Life Sciences carried out field trials as one-factor randomized blocks in four replications, in years 2013/14–2014/15. The one factor studied included:

1. Control (no biostimulator applied),
2. TS Impuls (autumn application at the phase of 6 leaves in a dose 0.5 dm^3 ha^{-1}),
3. TS Eva (spring application at the start of the growing season in a dose 0.5 dm^3 ha^{-1}),
4. TS Kveta (spring application at the budding phase in a dose 0.75 dm^3 ha^{-1}).

Mineral fertilization was applied before sowing at the following rates (kg ha^{-1}): 40 N, 60 P_2O_5, 120 K_2O, 30 S. Spring N fertilization ammonium nitrate at the rate of 90 kg ha^{-1} at the beginning of the growing season and urea (80 kg ha^{-1} N) during budding.

Immediately before the harvest, the following morphological features were examined in 10 plants from each plot: plant height, height of the lowest productive branch, number of lower (I) branches and number of siliques per plant. Twenty siliques from the main stem were examined and the following was recorded: number of seeds, seed mass per silique and post-harvest yield, mass of 1000 air-dried seeds and seed moisture.

A two-year trial has provided the basis for the conclusions:

1. Precipitation and temperature conditions in the years of the experiments significantly affected all the morphological features of pre-harvest plants, yield components and seed yield of rape.
2. Among the biostimulators assessed, the most beneficial impact on plant morphological features and seed yield was recorded for TS Impuls application which, considering long autumn vegetation, supported the rape growth most strongly.
3. Application of all TS type bio-stimulators, as compared to the control, contributed to an increase (about 4–9%) in seed and crude fat yields per hectare.
4. The use of bio-stimulators in the field practice may be an additional engine of the optimisation of rape agri-technology.

16. Tadeusz Wałkowski
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan

Yields of oilseed rape depending on increasing doses of nitrogen applied to the soil not limed and limed in habitat conditions the region of Podlasie

Liming the soil in Poland remained for decades the treatment necessary to compensate losses and acidification of soils and to maintain their fertility. Adjusting soil pH is a prerequisite for balanced fertilization. Field experiments were conducted in the growing

seasons 2013/2014 and 2014/2015 in the Podlaski Agricultural Advisory Centre in Szepietowo. A dose of calcium equal to 1.5 tonne CaO per 1 ha directly under rape (under plowing sowing), helped raise the soil pH by 0,3 units to the level of pH = 5.7 and 0.4 units to the level of pH 5.6. However, in the variant of the use of the same dose under forecrop (barley), the pH of the soil rose respectively to the levels of pH = 6.0 and 6.3. The use of lime fertilizer before sowing of winter rapeseed translate into increases in rapeseed yields by an average of 5.7%, while the application of lime fertilizer under forecrop rape translate into increases in yields of rapeseed by 11.2%. On average, liming acid soils increased the yield by 8.5%, regardless of where liming the soil in crop rotation. Both soil not limed and limed achieved significant increases in yields of rapeseed under the influence of increasing doses of nitrogen from 80 kg $N \cdot ha^{-1}$ to 160 kg $N \cdot ha^{-1}$. Under the influence of the dose of 200 kg $N \cdot ha^{-1}$ get seed yield at the same level as at the dose of 160 kg $N \cdot ha^{-1}$.

17. Marek Wójtowicz[1], Ewa Jajor[2], Andrzej Wójtowicz[2], Marek Korbas[2], Franciszek Wielebski[1]
[1] Plant Breeding and Acclimatization Institute – NRI, Division in Poznan
[2] Institute of Plant Protection – NRI in Poznan

Effect of protection against pathogens on yield of winter oilseed rape cultivars under high level of nitrogen fertilization

Winter oilseed rape throughout the growing season is infected by many pathogens. The incidence of the causes of diseases depends on the genetically controlled cultivar resistance and the impact of environmental factors. Apart from the cultivar susceptibility to infestation significant effect on the size of severity of disease symptoms exert weather conditions. Warm autumn and rainy spring favors plant infestation caused by pathogens. Another factor affecting the severity of the plant infestation is mineral fertilization. For the development and yield of oilseed rape is substantially dependent on the supply of plant nutrients, of which the most important is nitrogen, the relationship between the level of fertilization of this component and the severity of disease symptoms has been the subject of numerous studies. The disease symptoms are significantly constrained mainly by fungicide treatments. There is therefore the question, how these factors: habitat conditions, the level of nitrogen fertilization and intensity of protection against pathogens will influence not only the severity of the infestation but also the main agricultural feature – the seed yield. It is also interesting, whether you can expect significant differences between the cultivars as a result of the intensification of protection and nitrogen fertilization. These questions were tried to be solved in three-year (2009–2011) field experiment carried out in Łagiewniki Farm belonging to Plant Breeding Company ”Smolice”. The experiment was performed in split-plot design in four replications. The experiment objects were: open pollinated cultivar – ‘Casoar’ and composite hybrid cultivar – ‘Visby’. In the spring two levels of nitrogen fertilization (160 and 220 kg N/ha) were applied. In order to plant protection against causes of diseases three programs of chemical protection were used. The most intensive plant protection program consisted in fungicide applied in autumn at 4–6 leaf stage and in spring at stem elongation stage and at flowering. Less intensive plant protection consisted in fungicide applied two times in vegetation: at 4–6 leaf stage

and at flowering or in spring at stem elongation stage and at flowering. In autumn Horizon 250 EW at the dose of 0,75 l/ha was applied. In turn in early spring Caramba 60 SL at the dose of 1.25 l/ha, and in flowering Pictor 400 SC at the dose of 0.5 1/ha were applied. The investigations shoved efficacy of chemical protection in reduction of infestation by the causes of diseases (*Leptosphaeria* spp. – phoma stem canker, *Sclerotinia sclerotiorum* – stem rot, *Botryotinia fuckeliana* – grey mould, *Alternaria* spp. – dark leaf and pod spot). Plant protection against pathogens exerted also significant effect on yield. The highest seed yield was harvested from objects protected against diseases three times in vegetation period. The seed yield was also dependent on nitrogen fertilization level. Significant higher seed yield was achieved on objects fertilized with 220 kg N/ha. Seed yield was also influenced by cultivar. The 'Visby' cultivar produced a higher yield.

18. Franciszek Wielebski, Marek Wójtowicz, Stanisław Spasibionek
Plant Breeding and Acclimatization Institute – NRI, Division in Poznan

Yield and yield seed components of brightly and brown linseed varieties (*Linum usitatissimum* L.) in response to nitrogen and sulphur fertilization

The Plant Breeding and Acclimatization Institute – National Research Institute in the Poznań carried aut a two-factor field trials in years 2011–2012. The response of two linseeds varieties: Polish brown seeded variety Szafir, and the Czech yellow seeded variety Amon, to seven variants of fertilization with five nitrogen doses (0, 20, 40, 60, 80 kg $N \cdot ha^{-1}$) and two doses of Sulphur (0 and 10 kg $S \cdot ha^{-1}$) were investigated. According to the trial design, nitrogen was used in the ammonium nitrate (-S) or ammonium nitrate and ammonium sulfate (S +) altogether before sowing (20 or 40 kg $N \cdot ha^{-1}$) or divided into two parts and 40 kg $N \cdot ha^{-1}$ applied before sowing, while 20 or 40 kg $N \cdot ha^{-1}$ in herring bone phase (BBCH-15). The sulphur (10 $kg \cdot ha^{-1}$), was applied before sowing in the ammonium sulfate together with the nitrogen (40 and 60 kg $N \cdot ha^{-1}$).

Synthesis of two-year study showed that in the conditions of good soils in Łagiewniki the significant in comparizon with the control increase of seed yield of both varieties was obtained after application of 60 kg $N \cdot ha^{-1}$ and 10 kg $S \cdot ha^{-1}$, while a significant increase in the yield of straw was observed only in the yellow seeded variety Amon after application of 60 kg $N \cdot ha^{-1}$ and 10 kg $S \cdot ha^{-1}$, or after application of the highest dose of nitrogen (80 kg $N \cdot ha^{-1}$). The yield and efficiency of applied nitrogen were significantly influenced by weather conditions in the years of investigations. The highest productivity of nitrogen, and relatively low yields of seeds and straw was observed in the first year of the study, which was characterized by a deficiency of water in the initial period of growth, especially during flowering. Weather conditions also significantly shaped the plant density and plant habit and yield components, while fertilizer factor only insignificantly modified these characteristics. Higher values of analyzed traits were recorded in 2012, characterized by better hydro conditions in critical periods of water needs. Varieties only insignificantly differed in seed yield, while the yellow seeded variety Amon was characterized by a significantly higher yield of straw and a smaller plant density compensated by significantly greater number of branches and capsules per plant.

Key words: linseed, nitrogen and sulphur fertilization, yield of seeds, yield components, morphological traits.

19. Franciszek Wielebski, Marek Wójtowicz, Stanisław Spasibionek
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Effect of nitrogen and sulphur fertilization and plant density on fat content and fatty acid composition in oil of brightly and brown linseed varieties (*Linum usitatissimum* L.)

The subject of the study were seeds of linseed from two field experiments carried out in Lagiewniki (N 51°46' E 17°14') in 2011–2012. In the first experiment, reaction of two linseed varieties (brown – Szafir and brightly – Amon) fertilized with five nitrogen (0, 20, 40, 60 and 80 kg N·ha^{-1}) and two sulphur doses (0 and 10 kg S·ha^{-1}) was tested, while in the second, the response of varieties (brown – Bukoz and brightly – Jantarol) to five sowing density (400, 550, 700, 850, and 1000 seeds/m^2) was investigated.

Phosphorus and potassium fertilization in the doses of 60 and 90 kg·ha^{-1} respectively were applied before sowing in both experiments. In the first experiment, according to the trial design, nitrogen was used in the ammonium nitrate (-S) or ammonium nitrate and ammonium sulfate (S +) altogether before sowing (20 or 40 kg N·ha^{-1}) or divided into two parts and 40 kg N·ha^{-1} applied before sowing, while 20 or 40 kg N·ha^{-1} in herring bone phase (BBCH-15). The sulphur (10 kg·ha^{-1}), was applied before sowing in the ammonium sulfate together with the nitrogen (40 and 60 kg N·ha^{-1}). In the second experiment nitrogen was used at the rate of 60 kg N·ha^{-1} (40 before sowing and 20 in herring bone phase, BBCH-15).

Chemical analysis of seeds showed that the fertilization and seeding rates only insignificantly differentiated fat content in the seeds and fatty acids profile in oil of studied linseed varieties. These features were significantly differentiated by genetic factor. Varieties with yellow colored seeds (Amon 41.6% and 41.6% Jantarol) accumulated significantly more fat in seeds than varieties with brown color seeds (Szafir 39.6% and 39.8% Bukoz). Varieties differed in fatty acid content and in sum and the ratio of linoleic and linolenic acids.

Oil of varieties with traditional fatty acid composition (Szafir, Bukoz, Jantarol) was characterized by high (almost 60%) linolenic acid content (C18:3 ω-3) and an advantageous ratio of fatty acids: ω-6 to ω-3 (0.24:1), while the oil of low linolenic variety Amon contained up to 70.2% of linoleic acid (C18:2 ω-6) and was characterized by a highly unfavorable ratio of ω-6 to ω-3 (31:1). The composition of fatty acids was significantly influenced by hydro-thermal conditions in seed maturation phase. Lower temperatures in this period (2011) significantly increased linoleic and linolenic acids content in oil, while at higher temperatures (year 2012) significantly higher content of oleic acid was observed (C18:1 ω-9).

Key words: linseed, sowing density, nitrogen and sulphur fertilization, fat content, fatty acids profile.

20. Anna Wondołowska-Grabowska[1], Marcin Kozak[1], Elżbieta Skrzyńska[2], Andrzej Kotecki[1], Sylwia Lewandowska[1]
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Chemical analysis of selected linseed varieties characterized by different ability of microelements (Cu, Mn, Fe, Ni, Zn) and heavy metals (Cd, Pb) absorption from soil

In the years 2009–2011, in Experimental Station belonging to Department of Plant Cultivation in Pawłowice (eastern longitude 17°12´ and northern latitude 51°31) the field experiments using the method of blocks system have been carried out in four replications. In this work, 13 fibrous flax cultivars were subjected to analysis, all registered in such countries as France, Hungary, Netherlands, Romania, Czech Republic, Germany and Poland. Experiment was conducted on the soil classified as autogenic, brown soil order, originating from light clay on medium clay, assigned to agriculturally usable satisfactory wheat complex, and bonitation class III b with medium to very high phosphorous content, low to very high content of potassium, high to very high content of magnesium and slightly acidic reaction. Presowing fertilization of fibre flax included 46% triple superphosphate in the amount of 40 kg P ha^{-1}, 60% potassium salt in quantity of 70 kg K ha^{-1} and 46% urea. 34.4% ammonium nitrate was introduced in the form of top-dressing fertilization, while the total dose of nitrogen fertilization was 40 kg ha^{-1}.

The content of mineral and organic components have been determined, and specific yield, fat yield, protein and energy value of flax seeds per unit area have been calculated. It was found that from all metals (Ni, Cu, Mn, Zn, Pb, Cd, Ag) the highest accumulation in flax seed was recorded for zinc (more than 62 mg·1000 g^{-1}) and the least for Cd, which ranged from about 1.20 to 1.70 mg·1000 g^{-1}. The average content of Fe was more than 120 mg·1000 g^{-1}, and the content of silver (Ag) did not exceed a unity. Significantly higher Cu, Mn, Ni, Fe, Cd and Pb accumulation in flax seeds was found in 2011. Marylin variation originating from France, accumulated in the seeds important amount of heavy metals (Ni, Cd, Pb) and this significant value was the highest in comparison to the other twelve varieties. Polish version of Artemis (Artemida) was characterized by the highest content of Na and P in the seeds, while the seeds of Selena variety had the highest content of fiber and sodium.

Key words: fibre flax, mineral and organic composition, heavy metals.

21. Martina Větrovcová, Jana Poslušná
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Content of cadmium in poppy seeds (*Papaver somniferum* L.) in selected locations in the Czech Republic

Poppy (*Papaver somniferum* L.) belongs to important oilseeds and delicacies whose growing has a long tradition in the Czech Republic. Poppy is grown for seed production for food industry and for pharmaceutical purposes to isolate alkaloids as morphine, codeine, thebaine, papaverine or narcotine (noscapine). The limiting factor for poppy utilization

is heavy metals, especially cadmium. Despite of the low cadmium concentration in the soil, poppy reaches the highest cadmium concentration in the seeds. Samples for the analysis were collected from the selected experimental and farmer´s fields with poppy in Moravian-Silesian Region. Concentration of cadmium in poppy seeds was determined by graphite furnace atomic absorption spectrometry (GF-AAS). Homogenous samples of poppy seeds were digested by means of microwave digestion system using nitric acid and hydrogen peroxide as reagents. The measurements were carried out using an atomic absorption spectrometer (SOLLAR M, Thermo Electron Spectroscopy Ltd, Cambridge, UK) equipped with Zeeman and deuterium background correction. Analytical quality was checked through analysis of the reference material IRM 9091 red clover provided by ÚKZÚZ Brno, Czech Republic. Obtained results of cadmium content in poppy seeds were 0.197 to 0.795 $mg \cdot kg^{-1}$ and did not exceed the maximum limit specified by Czech legal code 0.8 $mg \cdot kg^{-1}$ (No. 399/2013). Monitoring of plants and looking for possibilities how to decrease the content of hazardous elements (cadmium) to minimum levels is the key factor in obtaining high quality and safe poppy products for consumers.

Key words: cadmium, poppy (*Papaver somniferum* L.).

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DISEASES AND PESTS

22. Eva Plachká[1], Jana Poslušná[2]
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The current occurrences of oilseed rape diseases on selected locations in the Czech Republic and the treatment indication

In Opava and Šumperk region the harmfulness of diseases in oilseed rape and signaling of fungicidal treatment have been monitored in the long term. It was confirmed the strong influence of the year (temperature, relative humidity) and crop rotation on the incidence of phoma stem cancer, white rot and others. The signaling of fungicidal treatment against important pathogens of winter oilseed rape as *L. maculans*, *L. biglobosa* and *S. sclerotiorum* was carried out based on the evaluation of ascospores and the course of weather conditions. The number of *L. maculans*, *L. biglobosa* ascospores in the air samples was determined by microscopic analysis of captured ascospores by spore trap. The percentage of petals contamination by *S. sclerotiorum* ascospores was determined by culturing them on a solid medium. The ample rainfall and consequently higher temperatures in the autumn and winter had a positive impact on the development of pathogens *Leptosphaeria maculans*, *L. biglobosa*. Numerous rainfall, cool and dry weather during the flowering period negatively affected the development of the pathogen *Sclerotinia sclerotiorum*.

The obtained results were funded by Ministry of Agriculture CR, NAZV grants QH81127 and QJ1310227.

23. Jana Poslušná[1], Ewa Plachká[2]
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[2] OSEVA PRO s.r.o., o.z. Výzkumný ústav olejnin Opava

Testing the susceptibility of *Leptosphaeria* spp. and *Sclerotinia sclerotiorum* pathogens against selected fungicides

The susceptibility of *Leptosphaeria* spp. and *Sclerotinia sclerotiorum* pathogens was tested against selected fungicides as Horizon 250 EW (a.i. tebuconazole), Efilor (a.i. boscalid, metconazole), Pictor (a.i. boscalid, dimoxystrobin) in 2013–2015. Tests of susceptibility were carried out at two workplaces in Šumperk and Opava. The isolates of fungal pathogens were collected from infected tissues of winter oilseed rape at commonly treated fields and from fungicidal untreated experimental plots with oilseed rape. Pure cultures of pathogens were obtained by following cultivation on solid defined medium (Czapek-Dox, PDA). Small parts of pathogen´s mycelium were placed on poisoned plates with different concentrations of active ingredients of fungicides. The initial concentration was determined based on the dose of 1 ha and the amount of spray mixture.

The most tested fungicide was Horizon 250 EW, used concentration scale was 0.2; 0.4; 0.8 and 1.6% solution of fungicide, when the concentration of 0.4% represented the registered dose rate of Horizon 250 EW allowed in Czech republic to control fungal diseases in oilseed rape. Since 2013 there were tested about 50 isolates of *Leptosphaeria maculans/ L. biglobosa* and about 30 isolates of *Sclerotinia sclerotiorum*. All tested isolates were susceptible. Presented results were obtained from project support MZe NAZV QJ1310227.

Key words: susceptibility, *Leptosphaeria* spp., *Sclerotinia sclerotiorum*, fungicides, winter oilseed rape.

24. Elżbieta Starzycka-Korbas[1], Michał Starzycki[1], Wojciech Rybiński[2]
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Williams test and its modification in the study of resistance oilseed rape *Brassica napus* L. to *Leptosphaeria* sp. infection

One of the main factors determining yielding of oilseed rape in Poland and the world is resistance to biotic stress. Researches related to the resistance of oilseed rape have been done to infection by the most dangerous fungal pathogens: *Leptosphaeria maculans* (Desm.) Ces. et de Not., conidial stage *Phoma lingam* (Tode ex Fr.) Desm. Purity species of pathogens which have been used in the study was verified using DNA sequencing ITS1. Seedlings of interspecific hybrids were used to the resistance test which have been obtained from a cross *B. oleracea* and *B. napus* (after 5 backcrosses). To assess of the resistance *Brassicaceae* plants including oilseed rape, there are used methods based mainly on the Williams test. This test is relatively simple but very time-consuming. Comparative study of Williams test and its modification without hurting cotyledons were performed. During the study were observed stronger effect of Williams test, which was characterized by the rapid infestation of cotyledons by conidiospores of *Leptosphaeria* sp. Based on results of both tests high correlation coefficient (0.77) was identified. The study is documented photographically and in tables (tab 1). Because of the easy way to test the resistance of rapeseed seedlings on a large scale, the modified (simplified) Williams test can be used to assess the plant immune system of each new strain of *B. napus*. Furthermore selected plants with the highest degree of resistance are used as components for crossing with the best lines of rapeseed in breeding programs related to *B. napus*.

Table 1. Pathogenity Indexes of identical oilseed rape genotypes examined by Williams test and its modification (without hurting cotyledons)

No.	Symbol of genotype	Infection index by Williams test	Pathogenity index by modified Williams test
1	2C413/08 10 Tau x B.n.	0.50	0.45
2	4C420/08 38B.t. x B.n.	0.65	0.30
3	6C297/06 p. (Jar x B.n.) x Calif.	0.05	0.05
4	8C 301 x 303 TP/06 p. Chor.	0.30	0.25
5	10C420/08 38B.t. x B.n./3	0.15	0.05
6	12C405/08 53 Bru x B.n.	0.35	0.25
7	14C301 x 303Chor. -	0.45	0.30
8	16C295 x 645TP/06(Br. X Bn)	0.55	0.40

No.	Symbol of genotype	Infection index by Williams test	Pathogenity index by modified Williams test
9	18C413/08 10 Tau x B.n./10	0.55	0.60
10	20C301x Digg.x(Chor.x Bn)	0.60	0.30
11	13C Star 105, 127, Chic 11	0.70	0.40
(Tau i B.t. – *B. taurica*); (B.n., Calif., Digg. Star 105, TP – *B. napus*); (Jar, Chor, Br., – *B. oleracea*)			

25. Elżbieta Starzycka-Korbas[1], Michał Starzycki[1], Wojciech Rybiński[2], Piotr Kamiński[3]
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Comparison of interspecific hybrids resistance seedlings in vitro and in vivo plants after pathogen inoculation of *Leptosphaeria* sp., *Alternaria* sp

The studies have been done in order to confirm resistance of interspecific hybrids obtained from the family *Brassicaceae* to infection caused by pathogenic fungus of the genus *Leptosphaeria* sp. and *Alternaria* sp. These researches were carried out to select genotypes showing the highest resistance to selected pathogens. Seedlings of interspecific hybrids have been tested using Williams test in in vitro conditions on the infection caused by the most serious fungal pathogens: *Leptosphaeria maculans* (Desm.) Ces. et de Not., conidial stage *Phoma lingam* (Tode ex Fr.) Desm. Purity species of pathogens which have been used in the study was verified using DNA sequencing ITS1, affiliation species were determined from the gene bank using the program NCBI/BLAST. Seedlings of the same interspecific hybrids were also tested for resistance to *Alternaria* sp. using the same method. After the resistance seedlings research using Williams' test, it was possible to indicate genotypes more resistant to infection caused by *Leptosphaeria* sp. and *Alternaria* sp. The analysis of the results is not difficult, but it can be burdened with some errors, because after verification of the results in the field have been noted no resistance correlation for most objects. The few genotypes have resistance in the field and laboratory conditions. Natural conditions stimulate elicitors in many cases, lacking in growth chamber. This fact (and other factors) can decide about the lack of correlation in in vitro and in vivo of the same genotypes.

Resistance tests to *Leptosphaeria* sp. and *Alternaria* sp. should be performed at the same time in the laboratory and the field. Results of both tests will select most resistant genotypes of interspecific hybrids necessary for resistance breeding.

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The sensitivity of *Sclerotinia sclerotiorum* to active ingredients of fungicides used for the oilseed rape protection

Oilseed rape is one of the most important crop plants in Poland. In Poland area of the cultivation is increasing. In 2014, the acreage of oilseed rape and turnip rape amounted over 950 thousand ha. Oilseed rape is grown for food production for oils and margarines and

for industrial purposes as a component of biofuels. Due to simplification of crop rotation and non-tillage cultivation, oilseed rape is more exposed to infection by plant pathogenic fungi. One of the most important diseases of oilseed rape is sclerotinia stem rot caused by a commonly occurring pathogen – *Sclerotinia sclerotiorum*.

The aim of the study was to evaluate the sensitivity level of *S. sclerotiorum* isolates to active substances of fungicides used in the oilseed rape protection against sclerotinia stem rot.

In the study 40 *S. sclerotiorum* isolates were used. Isolates was plated into PDA medium containing: azoxystrobin (strobilurin), boscalid (anilide), prochloraz (imidazole), tebuconazole (triazole) and thiophanate-methyl (benzimidazole) at concentrations of 1, 5, 10 and 25 ppm. In the following days the impact of the tested active substances for *S. sclerotiorum* colony linear growth inhibition was performed, and the sclerotium appearing was observed. Colonies growing on pure PDA medium were used as the controls.

Prochloraz and tebuconazole most effectively limited growth of tested *S. sclerotiorum* isolates, while azoksystrobin was the less efficient.

Active substances added to the medium at a concentration of 1 ppm do not lead to limit the growth of the tested isolates of *S. sclerotiorum*. The exception was prochloraz, which added to the medium at a concentration of 1 ppm resulted in significant colonies growth inhibition. The active compounds used at higher doses (5, 10 and 25 ppm) showed a high efficiency of more than 55% inhibition of colony growth, except azoxystrobin for which only the highest dose – 25 ppm reduced the growth of the isolates on average 53%.

All active ingredients used in concentrations of 1 and 5 ppm retarded the production of sclerotia up to six days. Thiophanate-methyl used in a concentration of 10 ppm resulted in inhibition of the sclerotia formation in most of the isolates. The other active substances used in 10 ppm dose delayed the formation of sclerotia in most of tested isolates up to twelve days. Boscalid, prochloraz and thiophanate-methyl applied at 25 ppm concentration resulted in the inhibition of sclerotia forming in 45–96.7% of tested isolates.

27. Małgorzata Jędryczka, Joanna Kaczmarek
The Institute of Plant Genetics of the Polish Academy of Sciences in Poznan

Pathotypes of *Plasmodiophora brassicae*, the cause of clubroot, in Poland

Winter oilseed rape (*Brassica napus*) is an important crop worldwide, including Australia, Canada, China and Europe, with Poland as one of the leading producers. Clubroot disease caused by the pathogen *Plasmodiophora brassicae* is a serious and still growing problem for oilseed rape growers on all continents and in many countries. The aim of this study was to evaluate the pathotype composition of *P. brassicae* populations from Poland, according to three well known classification systems. Moreover, the pathotypes were designated based on two different thresholds: 1) ID <25%, as proposed by Somé et al (1996); 2) ID <50% with the 95% confidence interval not exceeding 50%, as used by LeBoldus et al. (2012). There were considerable differences between the populations of *P. brassicae* calculated using different systems and various thresholds within the same system. According to ID <25%, a total of five pathotypes were identified using the differentials of Williams (1966), including 44% of plants classified as the pathotype 7. Meanwhile using ID <50% seven pathotypes have been found, with 6 and 7 present

in equal amounts (25% each). According to the European Clubroot Differential set (Buczacki et al. 1975) there were nine pathotypes each time, with six identical and three different ones, depending on the threshold. Only the system described by Somé et al. (1996) classified the isolates to identical categories, regardless of the threshold.

28. Henryk Woś[1], Ewa Jajor[2], Agnieszka Perek[2], Marek Korbas[2]
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In search of forms resistant to clubroot (*Plasmodiophora brassicae* Wor.) within the species of field mustard (*Brassica rapa* L.)

Rapeseed is the most important oleaginous plant in Poland and the European Union. However, our climate zone is characterised by a wide range of unfavourable conditions affecting the yield. One of them is clubroot (*Plasmodiophora brassicae* Wor.), which infests increasing areas of oilseed rape plantations in Poland. At present it is a disease of high economic significance. In practice, chemical methods to control of disease is not effective. When only agrotechnical methods are applied, they do not limit the pathogen with sufficient effectiveness. It seems that in view of this situation the breeding method, where we can use the sources of resistance of the ancestors, i.e. field turnip rape (*Brassica rapa* L.) and cabbage (*Brassica oleracea* L.), becomes particularly significant. The aim of the study was to identify forms of the *Brassica rapa* species with resistance or high tolerance to *Plasmodiophora brassicae*.

The research material consisted of 85 forms of turnip rape (winter and spring forms) and 3 cultivars of winter oilseed rape (Mendel, Alister and Tosca) as checks. The research was conducted at the stage of seedlings, in greenhouses, under strictly controlled conditions. There were 3 series of experiments with 4 replications. Rapeseed plants from different regions of Poland with clubbed roots infested with *P. brassicae* were used to prepare an inoculum. Six weeks after the inoculation we assessed the degree of infestation of the root system of the forms and cultivars under study. We used a four-degree scale, where 0 – no clubs on the root system; 1 – very small clubs on lateral roots; 2 – medium and large clubs on the main root (two thirds of the roots may be infested); 3 – the main root strongly covered with clubs, complete absence of lateral or very few lateral roots, the plant is completely damaged. Apart from that, we assessed the number of plants infested, expressing it as percentage and transformated to degrees on the Bliss scale. MSTAT statistical package (Michigan State University) was used for calculations.

The analysis of variance revealed significant ($p = 0.001$) differences the experimental series and between turnip rape forms used in this reaserch. We identified a few forms with very high resistance to clubroot. We calculated the coefficient of correlation $r = 0.96$ ($p = 0.01$) between the degree of root infestation by clubroot and the percentage of infested plants.

29. Jiří Havel
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The unusual abiotic and biotic damages of oilseed poppy (*Papaver somniferum* L.)

The poppy (*Papaver somniferum*) is very sensitive crop having the specific types of abiotic and biotic damages. Herbicides, soil conditions, weather and their combination are the frequent causes of abiotic damages. The specific type of herbicide deformation are spiral stems. Known are the damages caused by sequence of registered herbicides. The massive solidification of the soil can cause the fat growth of root neck or beet deformation of roots. Seedless capsules as the specific poppy damage are caused by influence of stres factors (herbicides, soil conditions, big amount of plant chemicals) at elongation growth phase followed by unpleasant weather at the blossom time.

The untypical biotic damages can cause the diseases *Fusarium* sp., *Sclerotinia sclerotiorum*, *Botryotinia fuckeliana* or bacterial infection. Visual symptoms of fusarial infection (orange coloured plant parts or pinkish mycelium) occure rarely only. The oft detected traces of fusariotoxins in the seeds suggest, that the hidden infection of poppy by Fusarium is possible. Sporadically occured *Sclerotinia sclerotiorum* and *Botryotinia fuckeliana* can infect stems and capsules too. The lower intensity of bacterial infection (*Erwinia carotovora* ssp. *carotovora*) causes the black coloured stem basis and root neck. Similar symptoms causes *Verticillium* sp. and these both infections can be maybe combined. If the pest damages are unusual, is discutable, because papaver stem midge (*Timaspis papaveris*) occures commonly but this pest is not too known. The poppy capsule weevil (*Neoglocianus maculaalba*) is well known in warmest growth area and it is extending now to the colder areas. The specific damages cause the hares and roes, when they eat only the buds in the elongation growth stage.

30. Mirosław Nowakowski[1], Paweł Skonieczek[1], Łukasz Matyka[1], Marcin Żurek[1], Teresa Piętka[2]
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Biomass yield and the impact of selected lines and cultivars of white mustard on the population of *Heterodera schachtii*

In 2015, a field experiment was conducted within task 2.7 in the Long-term Programme PBAI-NRI 2015–2020. The aim of the study was to evaluate the parameters of yield and the antinematode impact of doubly improved breeding lines of white mustard that came from the Research Division of PBAI-NRI in Poznan. The mustard lines were grown as a stubble catch crop, which is used more and more often in crop rotation with root crops as a green manure, antinematode factor and mulch. Seven breeding lines of white mustard were chosen: PN15/13 (1), PN23/13 (2), PN26/13 (3), PN83/13 (4), PN96/13 (5), PN473/14 (6) and PN312/14 (7) as well as the following control cultivars: Nakielska, Sirola and Warta. The experiment was set in a randomized block design with four replications on a black earth. The forecrop was oil radish. The white mustard lines and cultivars were sown in the first week of August and the harvest took place in the last week of October. On the experiment site, 50 kg N ha^{-1} in the form of ammonium nitrate were applied as well as 80 kg K_2O ha^{-1} in the form of potassium salt. The mustard seeds were sown in the

amount of 20 kg ha^{-1}. Before sowing the seeds and during the harvest, samples of the soil (0–30 cm) were collected to determine the number of eggs and larvae of the beet cyst nematode. After the harvest, the yield of fresh and dry mass of aboveground parts and roots was estimated.

An analysis of the study results has shown that in the group of white mustard lines, the following lines: PN473/14, PN312/14 and PN96/13 stand out with high yields of fresh and dry mass of shoots and roots. These yields were mostly higher than yields of the Warta control cultivar and lower compared to the cultivars of Nakielska and Sirola. Overall yields of dry mass obtained from the PN 473/14, PN312/14 and PN96/13 lines amounted to 50.9–55.6% of the dry mass contained in an average dose of cattle dung used to cultivate sugar beets. The cultivation of the PN83/13 and PN312/14 lines of white mustard greatly reduced the population of beet cyst nematode in the soil respectively by 34.8% and 28.0%, with the resulting antinematode effect significantly lower than that revealed by the cultivar of Warta.

31. Andrzej Wojciechowski[1], Marek Mrówczyński[2], Jacek Broniarz[3], Janetta Niemann[1], Henryk Wachowiak[2], Kamil Kolan[1]
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Susceptibilities of winter oilseed rape cultivars to infestation by root magot (*Delia radicum*)

Root magot (*Delia radicum*) is a serious pest in crops of plants of the genus *Brassica* in the temperate climate zone (Brown et al. 1999). This pest, causing crop damage contributes to loss in yield. So far, the presence of pests has usually been controlled by the use of insecticides, including, organophosphorus or carbamate insecticides treating seeds or seedling. Therefore, the EU prohibited seed treatment with over mentioned insecticide, it became an urgent need for the selection of resistant plants. Resistant crops are highly desirable in integrated plant cultivation (Verkerk et al. 1998) and are another alternative for the control of the aforementioned pests. Literature data relating to the resistance of plants to harmful insects indicates that in the *Brassica* species exists such resistance (Ruuth 1988, Bradshaw et al. 1989, Ellis, et al. 1999, Gavloski et al. 2000). Therefore in the present work it was decided to evaluate grown out of winter oilseed rape cultivars with respect to their resistancy.

In the years 2014 and 2015 were carried out observations on 47 winter oilseed rape cultivars, studied in the system of PDOiR experiments at the Experimental Station COBORU, Srem, province Wielkopolska. Observations on the enhanced presence of root magot were carried out in accordance with the EPPO methodology and the degree of damage caused by this pest was determined by 9-point scale.

All tested cultivars in greater or lesser extent, were colonized by root magot. At the same time, the degree of colonization of plants of each cultivar by root magot in the research was highly diversified. Metys and NK Caravel are two cultivars in which less than 30% of the plants in the two years of the study were infested by root magot. On the other hand, in the case of cultivars DK Excelium and SY Polana it was observed over 50% of plants infested by root magot in the two years of observation.

ANALYTICAL METHODS AND PROCESSING

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The influence of rapeseed moisture content and storage temperature on changes in technological quality of produced oil

Rapeseed is one of the most important oil crops, which seeds are raw material for the production of vegetable fats. For many years a strong upward trend has been observed in the worldwide production of rapeseed. Considerable interest in rapeseed production results from its high value as a raw material for the fat and oil, feed and engineering industries. It is a rich source of mono- and polyenic acids as well as natural oxidation inhibitors, i.e. sterols, tocopherols and phenolic compounds, exhibiting multifaceted probiotic properties. Among other things, the proportions of omega-6 and omega-3 acids in rapeseed oil are closest to those recommended by dieticians.

Quality of oil produced from rapeseed depends first of all on quality of seeds used in its production, thus after harvest they need to be properly stored. During long-term rapeseed storage, maintenance of suitable temperature-moisture conditions is essential. The increased water content in seeds intensifies seed respiration, enhances the activity of enzymes contained therein, and promotes growth of microflora, which leads to heating of the seed mass in some conditions. The consequences of a temperature increase comprise acceleration of the rate of adverse chemical and biochemical transformations occurring in seeds.

The aim of this study was to investigate the effect adverse storage conditions on increase in free fatty acid contents. Experimental material comprised seeds of rape cv. *Californium* stored in a thermostat chamber (25±1 and 30±1°C) equipped with three hygrostats used to maintain constant relative humidity. Prior to the experiment rape was wetted to moisture contents of 10.5, 12.5 and 15.5%. Seeds were stored until their germination decreased below 75%. During storage, samples were collected for analysis at every 6 days. Acid value (AV) was determined according to the standard PN – ISO 660, while contents of free fatty acids were expressed in mg $KOH \cdot g^{-1}$ oil.

Analysis showed a considerable effect of seed moisture content and storage temperature on the increase in free fatty acid contents. Acid value in samples of rapeseed collected from fields was 0,75 mg $KOH \cdot g^{-1}$ oil. In seeds stored at temperature of 25°C acid value after storage increased to 1.74 (10%) 2.11 (12.5%) and 6.36 (15.5%) mg $KOH \cdot g^{-1}$ oil. In seeds stored at 30°C acid value was higher and were 2.39 (10%) 2.62 (12.5%) and 8.83 (15.5%) mg $KOH \cdot g^{-1}$ oil.

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The influence of storage conditions on the quality and oxidative stability of *Camelina sativa* cold-pressed oil

One of cold-pressed oils that gain more and more customer attention is camelina sativa oil. The aim of this elaboration was to evaluate the influence of ligt and storage temperature on quality and oxidative stability of camelina sativa oil. Were examined the following quality factors: the degree of hydrolysis (acid value), primary oxidation products – peroxide value (PV), secondary oxidation products – anisidine value (AnV), fatty acid content, spectrophotometric colour and determination of oxidative stability via storage test (4°C and room temperature), Rancimat test (at 100°C), and Pressure Differential Scanning Calorimetry method (at 100°C).

Based on the results obtained from the study, it was found high nutritive value of camelina sativa oil (about 90% unsaturated fatty acids, of which more than 35% of the n-3 fatty acid). Significant influence of storage conditions on physico chemical quality and customer acceptance of analyzed oils was noticed. It was also said that it is correlation between induction time (from Rancimat and PDSC test) and peroxide and anisidine value, which was determined during the storage test indifferent conditions.

Key words: camelina sativa oil, oxidative stability, storage test, Rancimat test.

34. Anna Żbikowska[1], Małgorzata Kowalska[2], Mariola Kozłowska[3] Anna Grzybowska[1]
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Effect of natural antioxidants on quality of lipid fraction in the fat sponge-cakes

The aim of this work was to determine the changes in the quality of fat in thermostatted fat sponge-cakes obtained with and without added antioxidants.

In the study two following types of antioxidant were used: natural – green tea extract in three doses (0.02%; 0.2% and 1.0%) and synthetic BHA (0.02%) and 100%, solid bakery shortening (saturated fatty acids (FA) – 59%, monoenic FA – 34%, polienic FA – 2%, trans FA – 2%).

Fat sponge-cakes were thermostatted at temperatures 60°C after twenty-eight days. "Cold" extraction was done in room temperatures (approximately 22°C) for 60 minutes, immediately after baking, and every 7 days during storage.

In this study the quality of the lipid fraction was analyzed. The amount of primary (LOO) and secondary (LA) oxidation products was determined (PN-EN ISO 3960: 1996, PN-EN ISO 6885: 2001), free fatty acid content – LK (PN-EN ISO 660: 2005), and Rancimat test was performed, at 120°C (PN-ISO 6886:1997).

Baking caused changes in the values of the number of anisidine from 4.19 to 4.20, and the number of peroxide (LOO) from 1.96 to 2.11 meq O / kg. Addition of antioxidants to fats varied in degree of inhibition of oxidation processes of lipids fraction. Value of peroxide value after twenty-eight days of thermostatted was from 3.57 meq O/kg (BHA) and 11.14 O meq/kg (extract content – 1%) to 62.85 meq O/kg (control sample). In turn, the value of LA after the storage period ranged from 4.84 (BHA) and 6.71 (extract content – 1%) to 16.83 (control sample).

The best protective effects in the process of oxidation was achieved by BHA in the maximum permitted amount of 0.02%. The longest induction time (24.1 h) and the lowest peroxide value and anisidine value were obtained for this antioxidant. It was achieved after twenty-eight days of fat thermostating.

35. Karol Mińkowski, Artur Kalinowski, Anna Krupska
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The effect of preparation of seeds and choking of mass of seeds in expeller press on pressing parameters and quality of linseed oil

The aim of this study was to determine the effect of moisture and flaking of seeds and choking of mass of seeds in expeller press on chosen pressing parameters and quality of flax oil. Flax seeds of high linolenic variety "Bukoz" (IWNiRZ Poznan) have been investigated. Flaking of seeds was made in two rolled laboratory mill using smooth rolls. The oils were pressed in expeller press UNO of Farmet company. It was stated, that moisture of seeds, diameter of escape nozzle of press and flaking of seeds before pressing have a significant influence on pressing parameters and quality of oil. Increase of moisture of seeds from 6.7 to 8.6% results in increase of capacity of press from 7.8 to 8.8 kg/h, decrease yield of pressing from 81.6 to 71.9%, decrease of temperature of oil from 51 to 47°C and cake from 65 to 69°C, increase of water content from 0.39 to 0.43%, and in decrease of insoluble impurities content from 4.4 to 3.2%. The suitable level of moisture of seeds is between 7.5 and 9%. Decrease of diameter of nozzle from 10 to 6 mm results in decrease of capacity of press from 11.8 to 8 kg/h, increase yield of pressing from 69.5 to 77.6%, increase of temperature of oil, from 45 do 51°C, and cake from 65 do 69°C, and in increase of content of insoluble impurities from 3 to 3,3%. The suitable diameter of nozzle for processing of whole seeds is 8 mm. Flaking of seeds results in increase of capacity of press from 8 to 9.8 kg/h, increase yield of pressing from 77.6 to 80.7%, decrease of temperature of oil, from 51 do 44°C, and cake, from 66 to 65°C, and in increase of content of insoluble impurities from 3.3 to 4.6%. The suitable diameter of nozzle for processing of flakes is 6 mm.

Key words: flax seeds, linseed oil, cold pressing, expeller press.

36. Karol Mińkowski, Artur Kalinowski, Anna Krupska
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Influence of flaking and low-temperature hydrothermal treatment of flakes on pressing process parameters and quality of linseed oil

The objective of this study was to determine the influence of hydrothermal treatment of flakes on chosen pressing parameters and quality of flax oil. The examined material consisted of flaxseeds of high linolenic variety „Bukoz" from IWNiRZ (PL). Flaking of seeds was made in two rolled laboratory mill using smooth rolls, with slot 0,2 mm. Hydrothermal treatment of flakes was made for 3 h at temperature 50°C, in laboratory incubator. Flakes after treatment were dried in air flow dryer. The oils were pressed in expeller press UNO-SE, from Farmet (CZ). Temperature of materials was measured by laser thermometer. Content of water and volatile compounds in oil was determined according to method PN EN ISO 662:2001. Content of insoluble impurities in oil was determined according to method PN-EN ISO 663:2009. Flaking of seeds resulted in a increase of capability of press, from 8.5 to 10.6 kg/h, yield of oil, from 72.0 to 73.5%, decrease of temperature of oil, from 48 to 43°C, and cake, from 68 to 64°C. Hydrothermal treatment of flakes resulted in a increase of capability of press, from 10.6 to 13.5 kg/h, yield of oil, from 72.0 to 73.5%, increase of temperature of oil, from 43 to 47°C, and cake, from 64 to 68°C, and also increase of content of insoluble impurities in oil from 4.0 to 4,2%. Increase of content of peroxides from 0.80 do 1.48 meq. O_2/kg has also been observed. Flaking of seeds before pressing has a significant beneficial effect on capability of press, yield of oil and temperature of oil and cake. Hydrothermal treatment of flakes results in beneficial increase of capability of press and yield of oil, and in negative increase of temperature of oil and cake. Flaking of seeds makes evident increase of content of insoluble impurities in oil, and hydrothermal treatment of flakes has positive effect on sensory features of oil but promotes its oxidation.

Key words: flax seeds, flaking, hydro-thermal treatment, pressing, linseed oil.

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Effect of enzymatic pretreatment of seeds on pressing process parameters and quality of linseed oil

Mechanical destruction of seeds and partially open of seeds cells importantly helps of extraction of oils from raw material. Farther open of cells can achieve by enzymatic hydrolysis grinding seeds. The objective of the study was to determine the effect of enzymatic pre treating of seeds by added enzymes on some selected parameters of pressing process in a expeller press and the quality characteristics of linseed oil. The initial research material consisted of flaxseeds of the 'Bukoz' high linolenic variety (IWNiRZ, Poznan, PL). Enzymatic treatment was done on flaked seeds. The flakes of 20% of moisture were submitted to enzymatic treatment in temperature of 50°C for 3 hours. Flakes were next dried in an air flow dryer. The oils were pressed in an UNO-SE expeller press manufactured by Farmet (CZ). Cellulase and protease enzymes such as Celluclast 1.5 L and Alcalase 2.4 L preparations and their mixtures in proportion 10:90 and 50:50, and doses: 0.125, 0.25, 0.50% ddm were used. Both preparations were delivered by Novozymes A/S (DK). The enzymatic treatment of flaxseeds before cold pressing contributed to the increase in the press capacity as well as in the oil yield and further, it contributed to the decrease in the cake temperature. The highest yield of pressing (79.8%) was obtained when mixture of cellulase and protease enzymes in proportion 10:90 and dose 0.25% ddm was used.

Enzymatic treatment resulted in slight increase in the acid value and content of primarily and secondary oxidation products in cold pressed oil. Moreover the process caused that the amount of natural antioxidants in oil – phenolic compounds and tocopherols slightly increased too.

Key words: flax seeds, enzymatic treatment, cellulase, protease, cold pressing, linseed oil.

38. Lenka Endlová[1], Andrea Rychlá[1], Zuzana Navrátilová[2], Viktor Vrbovský[1]
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Estimation of fatty acid content in the intact seed of oilseed crops using near infrared spectroscopy with regard to the quality of the resulting vegetable oil

Oilseed genetic resources from the collection of National Programme on Conservation and Utilization of Genetic Resources Plant and Agrobiodiversity are annually tested in the field trials at the workplace OSEVA PRO Ltd at Opava. The collection contains 10 species of spring oilseeds and two species of winter ones. Manually harvested seed samples are used to the chemical analyses of content of economically important substances. The large amount of annual analysis need to use near-infrared spectroscopy (NIRS) as a screening method for determination of oil and fatty acids content in the seed samples.

The aim of the study was to determine the oil and fatty acids content in the seed samples using NIRS. These oilseed species were analyzed: oilseed rape (*Brassica napus* L.), turnip-rape (*Brassicca* ssp. *oleifera rapa*), camelina (*Camelina sativa* L.), poppy (*Papaver somniferum*), white mustard (*Sinapis alba* L.), chinese mustard (*Brassica juncea*), black mustard (*Brassica nigra*), rocket salad (*Eruca sativa*) and crambe (*Crambe abyssinica*). NIRS exhibited as an effective method for the rapid and sufficiently accurate identification and monitoring of the tested qualitative parameters. The results show a significant variability of the qualitative composition of the vegetable oils of the tested species and even of the particular genotypes, which is caused by the different fatty acids composition. These differences within the genetic resources offer the breeding of varieties with required oil quality.

Key words: oilseed, fatty acids, near-infrared spectroscopy, vegetable oil.

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Studies on the effect of rapeseed and linseed oil fatty acids composition on selected parameters of ethylcellulose oleogels

The usage of oil hydrogenation is abandonment because during this process trans fatty acids are formed. This compounds are undesirable in the diet because it may have bad influence on cardiovascular diseases because of rising LDL cholesterol fraction in the

blood. Unmodified oils have high content of unsaturated fatty acids, which have desirable effect on humans body. The most popular oil in Poland is rapeseed oil, although cold pressed oils are becoming more popular such as linseed oil, which has high content of α-linolenic acid. To modify the consistency from liquid to solid the novel methods are used, one of them is oil structuring by ethylcellulose (EC). Structured oils, ie. oleogels, may form gels of different hardness and consistency. Textural properties of the gels are associated with EC particle size, the greater are the stronger gels form.

The effect of fatty acids composition on the EC oleogels has been investigated in this study. The following oils were used: rapeseed and linseed. As a oil structuring material ethylcellulose (45cP) was used. The content of EC in oleogels was 8%.

Oils with the addition of EC were heated to 150°C and stirred. Control samples without the addition of structuring compound were prepared the same way. Control samples after cooling down to room temperature were liquid and their viscosity did not increase significantly. The texture of obtained oleogels was tested by double compression, in which it was observed that EC with linseed oil forms much harder gels (4.46 N) than rapeseed (0.64 N). It is associated with much higher amount of polyunsaturated fatty acids in linseed oil (71.3%) than in rapeseed oil (26.6 %) and increased content of peroxides formed during heating.

40. Edyta Popis, Katarzyna Ratusz, Zuzanna Bajorek, Krzysztof Krygier
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology

Assessment of the oxidative stability of linseed oil

Linseed oil has a large number of unsaturated fatty acids, particularly α-linolenic acid (ALA, omega-3), which content is more than 50%. However, a large content of unsaturated fatty acids makes this oil easily oxidized. Oxidation process is not only affects by fatty acid composition, but also impact on oxidation has a content of other pro- or antioxidant activity components. On the market are available both cold-pressed and refined linseed oil. Refined oils compared to cold-pressed are usually characterized by a higher stability, therefore aim of the study was to evaluate the stability of cold-pressed and refined linseed oil.

The research material consists of three linseed oils, two cold-pressed and one refined. The linseed oils were tested in schaal oven test at 62°C for ten days. During the test, each day in oils were determined: primary oxidation products – peroxide value (PV), secondary oxidation products – anisidine value (AnV), oxidative stability in the Rancimat test at 100°C, the contents of carotenoid pigments expressed as β-carotene and viscosity. In addition, fresh oil were analyzed by the fatty acid composition and the content of free fatty acids (AV). The results were correlated, determining the influence of individual quality features on linseed oil oxidative stability in Rancimat test.

The content of primary, secondary oxidation products, and viscosity increased during the schaal oven test. After ten days of the test, peroxide content in all oils exceed 70 mEq O_2/kg, refined oil was characterized by a slightly lower peroxide value than cold-pressed oils. Anisidine value in all oils exceeded 40. With the passage of thermostating time oil oxidative stability decreased, oxidation induction time reduced for all tested oils. The induction time obtained in Racimat test was strongly correlated with the peroxide value.

41. Edyta Popis, Katarzyna Ratusz, Krzysztof Krygier
Warsaw University of Life Sciences – SGGW, Faculty of Food Sciences, Division of Fats & Oils and Food Concentrates Technology

Effect of seed pretreatment on poppy oil quality

Poppy seed oil (*Papaver somniferum* L.) is used primarily for culinary purposes, but also in the pharmaceutical industry or for the production of soap and paints. Poppy oil is characterized by a high content (approx. 70%) of unsaturated acids from n-6 group, mainly in the form of linoleic acid. The high content of unsaturated fatty acids promotes greater susceptibility of oil to oxidation – the main cause of oil deterioration during storage. However, numerous studies suggest that seed pretreatment can increase the oxidative stability of the oil. Therefore, the aim of this study was to investigate the effect of pre-heat treatment of poppy seeds on resulting oil quality, including oxidative stability.

The research material consisted of gray poppy seed oils obtained by cold pressing with pretreatment. Poppy seeds before pressing were heated for 1 hour at 100°C and 150°C. The control sample was the oil pressed from seeds without heating. Pressing was carried out using screw press Farmer 10, with nozzle diameter of 8 mm. The resulting oils were analyzed by acid value, peroxide value, anisidine value, and the Totox indicator was calculated. Moreover, the contents of dienes, trienes and pigments (chlorophyll and carotenoid) were determined. Tested oils were also analyzed by the fatty acid composition and the oxidative stability in Rancimat and a high pressure differential scanning calorimetry (PDSC) test. In addition, the antioxidant capacity of the oil was determined by free radical DPPH.

The obtained results revealed that seed heating had no effect on the increase of free fatty acids, however the content of peroxides and secondary oxidation products in the oil increase with heating temperature. The tested oils did not differ significantly in terms to fatty acid composition. The oxidative stability of gray poppy seed oils in both Rancimat and PDSC test rising with temperature of seed pretreatment.

42. Artur Kalinowski
Institute of Agricultural and Food Biotechnology in Warsaw

The effect of tempering the solid content of cocoa butter selected sample

In this work, the chemical and physical properties of cocoa butter with special emphasis on its polymorphic forms were discussed. Findings on influence of the method for thermostating upon the solid fat content of selected samples of cocoa butter and its equivalents were shown. NMR was used to determine the solid fat content. Two methods for thermostating fat sample were used before analysis. It was affirmed that the method for thermostating fat samples significantly influences the melting course. The long stabilization of fat (40 hours at 26°C) caused an increase in solid fat content over 20°C, and a violent decrease was observed at 35°C.

43. Artur Kalinowski[1], Patryk Piwowarek[2]
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Olive oils extra virgin – characteristics of selected species based on fatty acid composition

Essential role in qualitative evaluation and classification different sorts of olive oil extra virgin play the sensory analysis, so the taste and smell. Another basic index of olive oil extra virgin identification is fatty acids composition which points at species and purity of assortment. On quality of used the raw material provides also analysis of isomeric diacylglycerols (DAG) content. Execution of these two analysis identifies olive oil extra virgin in principle and allowed to show the need of further qualitative tests like characteristics of triacylglycerols, sterols, stigmastadiens or waxes. The wide range of olive oil examinations shows the importace and scale of difficulties for characterizing this product. The complete register of analysis are in the documents of UE (No 1348/2013).

The aim of the work was estamination of foreign olive oil extra virgin from different countries of Europe like Spain, Italy, Greece, France in conditions of domestic laboratory with using of chromatographic methods for identification and specification of analytical quality of products.

Key words: olive oil, fatty acid composition.

BIOLOGICAL VALUE OF OIL AND MEAL

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Chemical characteristics of meals obtained from new genotypes of yellow and black-seeded winter rapeseed

INTRODUCTION

Growing demand for high-protein plant components of feed, as well as high prices of soybean meal increase the importance of alternative sources of protein, available on the agricultural raw material market. In Poland, their meaning is heighten by the prohibition of using the genetically modified feed components in animal nutrition, that will come into effect from January 2017. On European market rapeseed meal is the cheapest and most important source of protein for livestock. It contains 35–40% of protein of well-balanced amino acids composition but its full utilization by animals is limited.

The aim of the study was to examine and compare the chemical composition of meals produced from seeds of various 'double zero' rape genotypes, differing in colour of hulls and industrial soybean meal.

MATERIALS AND METHODS

The material for the study consists of six rapeseed meals (RSM) obtained from seeds of winter rape (RS) and included three very advanced lines of yellow-seeded genotype (lines no. 1038; 1027/3i; 1058/6i) and three recently registered varieties (Monolit, Brendy and Konkret) of black-seeded genotype. The yellow-seeded lines were obtained from the IHAR-PIB Branch in Poznań, while black-seeded varieties from the Strzelce Plant Breeding Company, all harvested in 2014. RSM were laboratory prepared by hot hexane extraction. For comparison purposes commercially available soybean meal (SBM) was included. Meals were analyzed for content of dry matter, gross energy, residual lipids and basic nutrients, like protein, minerals and sucrose. It was also determined contents of fibre by Uppsala method and total polyphenols. All chemical analyses were done in duplicate, and the results expressed on basis of fat-free dry matter (ffdm).

RESULTS AND DISCUSSION

Comparing the chemical composition of RSM it was found that yellow-seeded rapeseed meals had significantly more protein than the meals obtained from black-seed RS (47.1 vs. 39.3%). The average content of other basic nutrients in all rapeseed meals was comparable. The highest amount of energy (4716 kcal/kg), protein (48.7%) and minerals (8.9%) was found in the line no. 1027/3i. In comparison to SBM, the RSM were characterized by higher content of sucrose and minerals, but had slightly lower content of protein and brutto energy. The greatest difference in chemical composition between yellow

and black-seeded meals was shown in content of dietary fibre. The average content of this compound in meals obtained from yellow-seeded breeding lines was about 28% lower as compared to its quantity indicated in black-seeded meals. The differences in content of TDF between meals of yellow and black colour of seeds were mainly due to the differences in the content of Klason lignin, about 4-fold lower in yellow-seeded meals than in the black counterpart (3.5 vs. 13.5%). In comparison with the SBM, yellow-seeded meals were characterized by higher average content of nonstarch polysaccharides (9%), and uronic acids (29%), but lower amount of oligosaccharides (by 47%) and lignin (by almost 18%). These differences were even greater in relation to the meals obtained from black-seeded varieties. As a result, dietary fibre content in SBM is comparable to the amount in the yellow-seeded meals but about 28% lower than in black-seeded meals.

CONCLUSIONS

- Meals obtained from the yellow-seeded rapeseed had significantly more protein than meals of black-seeded varieties.
- In general, content of protein in rapeseed meals was significantly lower than that in soybean meal.
- The yellow-seeded rapeseed meals were characterized by significantly lower content of dietary fibre as compared to black-seeded counterparts.
- The difference in content of total dietary fibre between yellow- and black-seeded meals resulted primarily from differences in content of lignin.
- Content of dietary fibre in yellow-seeded meals was comparable to its quantity in soybean meal.

Key words: black- and yellow-seeded rapeseed meal, nutritional value, dietary fibre, protein.

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45. Elżbieta Kondratowicz-Pietruszka
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The quality of selected margarines Polish market

In the recent years the population has been increasingly concerned with health related matters. Food, apart from supplying necessary nutrition components for the human organism, and providing sensual satisfaction, should be also of proper health quality and ensure health safety of consumers. The increase of interest in the so called “health food” of warranted quality was stimulated by the dynamic development of food industry, the creating of consumer market, growing competition and increasing consumer awareness and requirements. A very broad offer of plant fats in Poland allows consumers to choose from a wide range of products offered on the market. Consumers expect that hardened plant fats will not be harmful to health and provide proper nutrition qualities, desirability and sensual acceptance, reasonable price and availability of product. The composition of edible fats should – inasmuch as possible – comply with current nutrition recommendations, including those related to the content of saturated fat acids, trans-isomers and the level of metal elements content.

The purpose of the study was the analysis of the composition of fat acids and the content of nickel and cadmium elements in 22 selected samples of popular cup margarines present on the Polish market and bought in retail shops.

Fat acids were analysed in the form of methyl esters with the use of SRI 8610 gas chromatograph with Restek RTX-2330 column. As a result of the analysis acid profiles of margarines were obtained. The length of fat acid carbon chains ranged from C6:0 to C18:3, whilst C20:3 (cis-8,11,14) was found only in one sample in the amount of 0.31%. The contents of saturated acids varied between various kinds of margarine and ranged from 22.75% to 68.86%. C18:1 (trans-9) isomers were found in 13 samples and their content varied from 0.44% to 21.02%, whilst C18:2 (trans-9,12) isomers were found in two samples and their content varied from 0.28% to 0.32%. The content of metal elements in margarines was determined after their mineralisation in a Milestone Start D microwave with the use of 65% HNO_3 and 30% H_2O_2 (7:1 v/v) in 200°C. The ASA atomic absorption method was used for this purpose. The contents of metal elements in analysed margarines varies in the following ranges: Ni – from 15.485 ppb to 264.640 ppb, Cd – from 0.000 to 15.545 ppb. The results show that the allowable threshold of the contamination with nickel (0.20 mg/kg in two samples) was exceeded.

46. Małgorzata Wroniak, Agnieszka Rękas, Katarzyna Ratusz
Warsaw University of Life Sciences, Faculty of Food Sciences, Department of Food Technology

The influence of impurities in raw material on sensory quality and physico-chemical properties of oil

The effects of different contents of impurities in seeds of rape, originated from conventional (seeds of individual cultivars and industrial seeds) and certified ecological seeds, on the sensory quality, physicochemical properties and oxidative stability of rapeseed oil produced by cold-pressing were investigated. The seeds homogenous in terms of cultivar contained the lowest content of impurities (up to 1.3%) and differed significantly in this regard from the ecological and industrial seeds. It was found that the presence of impurities exert an adverse effect on the sensory and physicochemical characteristics of the oil. The content of impurities exceeding 5% resulted in the appearance of off-flavours, such as woody, strawy and fusty/musty. Furthermore, a positive correlation was found between impurities content and acid value ($r = 0.781$), peroxide value ($r = 0.656$), anisidine value ($r = 0.645$) and Totox index ($r = 0.690$), K_{232} ($r = 0.625$), while in the case of oxidative stability no such correlation was observed. It seems advisable, therefore, to minimize the content of impurities, in order to obtain a high quality cold-pressed rapeseed oil.

Key words: rapeseed, impurities, conventional, ecological, cold-press, quality, sensory evaluation.

47. Małgorzata Wroniak, Agnieszka Rękas, Anna Piekut
Warsaw University of Life Sciences, Faculty of Food Sciences, Department of Food Technology

The effect of hydration and microwave heating of rapeseed on the quality and yield of oil

The aim of this study was to identify how hydration and microwave heating of rapeseed before pressing, affects the quality and efficiency of the oil. The research material of the study were two varieties of rapeseed – Monolit and Brendy. The seeds were prepared

by moistening to a humidity of 7.5 %, microwave heating for 4 or 8 minutes, re-moistening to a humidity of 6, 7 or 8%, subsequently the oil was cold pressed by using screw press. Not only sensory and physic-chemical characteristics, but also oxidation stability of obtained oils and pressing process efficiency have been defined. On the basis of obtained results, it was found that microwave treatment of seed, applied before pressing, has increased the efficiency of extruding process, in comparison to the efficiency of oil made from unheated seeds. Thermal treatment of seeds before pressing has changed the sensory characteristics of the oil. Along with the increase of the time of heating, color of the oil has changed from bright green to dark brown. At each degree of humidity in both varieties of rapeseed, together with the increase of heating time of seed, physico-chemical quality of the oil has deteriorated. There was an increase in the degree of hydrolysis and oxidation (primary and secondary), as well as the level of dienes (A232) and trienes (A268). At the same time, there was a noticeable increase in oxidative stability of oils in the Rancimat test.

Key words: rapeseed, microwave heating, rapeseed oil, yield of oil, quality, oxidation stability.

48. Małgorzata Wroniak, Katarzyna Ratusz, Agnieszka Rękas, Daria Prejs
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The evaluation of selected quality wheat and potato snacks fried in fat with different thermal stability

Nowadays, more and more popular among consumers become fried snacks products. Among them we single out crisps (snacks) obtained from semi-finished type of pellet. During frying pellets are expanding, so why they get specific crisp and delicate texture. The aim of this study was to determine the effect of type of fat used for frying on the quality of wheat and potato snacks and rating the degree of fat degradation after frying. Wheat and potato pellets were fried in 4 different fats: refined rapeseed oil, rapeseed cold pressed oil, olive oil, lard and to compare ready trading snacks fried in palm fat. In snacks marked the content of water, fat, texture and microstructure, while in fats degree of hydrolysis and oxidation, oxidative stability. Found high content of fat in fried wheat snacks from 21.56% in cold pressed oil to 32.96% in palm oil. The potato snacks from 19.61% in cold pressed oil to 38.76% in palm oil. Type of fat which was used for frying had no significant effect on texture of snacks. Observed significant deterioration in the quality of used frying fats. The biggest changes was found in rapeseed cold pressed oil, while the smallest in olive oil. In Rancimat test confirmed the highest oxidative stability of olive oil.

Key words: snacks, frying, quality, texture, microstructure, fats.

49. Agnieszka Kita, Joanna Miedzianka, Agnieszka Nemś
Wroclaw University of Environmental and Life Sciences, Department of Food Storage and Technology
Characteristics of physico-chemical properties of flours from meals after oil cold-pressing

The aim of the investigation conducted was determination of physico-chemical properties of eight flours obtained of meals after oils cold-pressing. The material used

for investigation were flours of pumpkin seeds, flax, evening primrose, milk thistle, corn germs, almonds, peanuts and coconuts. The following parameters were the subject of determination: moisture, fat content and fatty acid composition, protein content and amino acids composition, fiber, and colour. Additionally polyphenols content as well as antioxidant activity – by ABTS method, of obtained flours were measured.

The investigation proved that the highest fat content exhibited coconut flour. The fat content in other products was below 15%. The best protein source (above 50%) were flours of pumpkin seeds, peanuts and almonds, while the lower protein content exhibited grounded meals of coconuts and corn germs (below 20%). The flour of pumpkin seeds characterized the highest content of total as well as essential amino acids. The lowest content (about four times) of amino acids was observed in flours of corn germs and coconuts. The fiber content in meals of evening primrose, milk thistle and coconuts was 6–9 folds higher then in flours of corn germs, pumpkin seeds and peanuts. The colour of flours was determined by properties of raw material. The lightest colour exhibited flours of coconut and corn gems, while the darkest of evening primrose. The flour of evening primrose exhibited the highest polyphenol content and antioxidant activity. The lowest content of polyphenols characterized flours of coconuts and pumpkin seeds.

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50. Sylwester Czaplicki, Małgorzata Tańska, Dorota Ogrodowska
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The use of natural antioxidants of sea buckthorn and amaranthus oils to the oxidative stabilization of bio-oil from the seeds of viper's bugloss

Bio-oil obtained from viper's bugloss seeds is a mixture of triglycerides with different fatty acid composition. Particularly valuable in the oil are polyunsaturated fatty acids (stearidonic, γ- and α-linolenic, linoleic), accounting for almost 74% of total fatty acids. However, high concentration of these fatty acids makes the oil more susceptible to oxidation. The theoretical oxidizability for the oil is 1.46 and is approx. 25% higher than that of linseed oil, known for its low shelf life. The natural way to improve the stability of the product may be the addition of antioxidants extracts from plant raw materials rich in these ingredients, e.g. in the form of oil. For this reason, the aim of the work was to examine the effect of sea buckthorn (source of carotenoids and tocopherols) and amaranthus (source of squalene and tocopherols) oils addition on oxidative stability of bio-oil from viper's bugloss seeds.

The research material were cold-pressed oils from viper's bugloss and amaranthus seed made in the laboratory, and oil from sea-buckthorn berries purchased from the market. The viper's bugloss, amaranthus and sea buckthorn oils were mixed in proportions of 70:25:5 and 65:25:10, which were based on preliminary studies evaluating changes in fatty acid composition and color prepared mixtures. The study investigated the efficiency of added antioxidants in the viper's bugloss oil stabilization. It was determined by the measure of induction time in the Rancimat test, and analysis of the hydrolytic and oxidative changes during storage at room temperature.

It has been shown that the addition of amaranthus and sea buckthorn oils to the viper's bugloss oil extended induction time by more than 50%, while maintaining a relatively high proportion of polyunsaturated fatty acids with 3 and 4 double bonds (>25%). Furthermore, with regard to the content of natural antioxidant prepared mixtures were richer in relation to the viper's bugloss oil. They contained more bioactive compounds, especially β-carotene, α-tocopherol and squalene. These compounds effectively inhibited oxidation of the unsaturated fatty acids during storage of the mixtures, as indicated approx. 4 and 0.5-fold lower peroxide and anisidine values, respectively. At the same time, there was a gradual degradation of the bioactive compounds. The greatest change in content was observed in the case of tocopherols, then carotenoids, while squalene was the most stable compounds.

51. Beata Paszczyk, Ryszard Rafałowski, Joanna Klepacka
University of Warmia and Mazury in Olsztyn, Chair of Commodity Science and Food Analysis

Composition of fatty acids in refined vegetable oils occurring in trade

The aim of the study was to assess the composition of fatty acids in refined vegetable oils occurring in trade.

The study included 18 different types of refined vegetable oils among which were 8 rapeseed oils, 3 sunflower oils, 2 soybean oils, 1 corn oil, 2 arachide oils and 2 olive oils. The oils were purchased in retail stores in Olsztyn and they originated from different manufacturers, both domestic and foreign.

Fatty acid methyl esters (FAMEs) from analyzed oils were prepared according to the Peisker method. The fatty acid composition was determined by gas chromatography (GC) method using a HP 6890N gas chromatograph with flame ionization detector (FID), capillary column 30 m long and an inner diameter of 0.32 mm with Supelcowax liquid phase 10 (0.25 μm). The following separation conditions were applied: column with temperature 180°C, detector temperature was 250°C and injector temperature maintained at 225°C, helium carrier gas flow was 1 ml/min at a split ratio 50:1.

The analyzed oils were characterized by varying composition of the individual groups of fatty acids. The share of saturated fatty acids ranged from 7.14% in rapeseed oil to 19.40% in peanut oil. The largest amount of monounsaturated fatty acids (from 69.73% to 72.64%) contained olive oil. Analyzed rapeseed oils were characterized by the presence of this group of fatty acids at the range of 61.86% to 65.78% and peanut oils from 56.53% to 59.38%. In other oils monounsaturated fatty acids occurred in minor amounts: from 27.16% to 31.80% in sunflower oil, 31.17% in corn oil and 31.2% in soybean oils. Sunflower oils contained the highest amount of polyunsaturated fatty acids (from 53.24% to 58.15%), high content of these acids occurred also in soybean oil (from 51.40% to 51.76%) and corn oil (50.12%). The lowest content of polyunsaturated fatty acids (from 8.94% to 11.25%) was determined in olive oil.

Based on this study it can be concluded that refined soy, sunflower and corn oils appearing on the Polish market are a valuable source of polyunsaturated fatty acids while rapeseed, peanut and olive oils can be a good source of monounsaturated fatty acids.

52. Ryszard Rafałowski, Joanna Klepacka, Beata Paszczyk
University of Warmia and Mazury in Olsztyn, Chair of Commodity Science and Food Analysis

The content of the tocopherols in refined vegetable oils occurring in trade

The aim of this study was to evaluate the composition of the tocopherol isomers in refined vegetable oils occurring in trade.

The study included 19 different types of refined vegetable oils (8 rapeseed oils, 3 sunflower oils, 3 soybean oils, 1 corn oil, 2 arachide oils and 2 olive oils).The oils were purchased in retail stores in Olsztyn and they originated from different manufacturers, both domestic and foreign.

Analyzed oils in an amount of 1 g were dissolved in hexane, placed overnight in the dark place and centrifuged prior to assay. Tocopherol isomers were determined by HPLC method using a liquid chromatograph Hewlett Packard 1050 and the following separation conditions: column length 250 mm, internal diameter 4 mm, filling: LiChrospher Si 60 (5 μm); mobile phase: 99.3% hexane and 0.7% isopropyl alcohol; flow 1.5 ml/min, a fluorescence detector with excitation at 295 nm and emission at 330 nm. The equivalent of vitamin E content (CE) was calculated in analyzed oils.

The results indicate that all refined oils contained α-tocopherol. The highest content of this compound (from 62.02 to 74.8 mg/100 g) was found in sunflower oils, rapeseed oils contained α-tocopherol at the level 31.80 mg/100 g (from 28.04 to 36.20 mg/100 g) and the comparable amounts (from 29.70 to 28.23 mg/100 g) were detected in soybean oils. The lowest content of isomer α-contained peanut (1.43 to 16.33 mg/100 g) and olive oils (29.29 to 47.58 mg/100 g). The highest content of β-tocopherol was found in refined soybean oil (86.15 mg/100 g) while its amount in sunflower oil was 3.77 mg/100 g and in olive oil 2.74 mg/100 g. Among refined oils the highest content of γ-tocopherol contained soybean (103.56 mg/100 g) and corn oil (98,46 mg/100 g) while the lowest amount of this compound was detected in sunflower oil (5.24 mg/100 g). δ-tocopherol was found in one refined soybean oil in an amount of 43.42 mg/100 g. The highest content of vitamin E equivalent (67.32 mg/100 g) was detected in sunflower oils, while the lowest (11.23 mg/100 g) in peanut oils.

The results indicate that the same type of refined oils produced by various manufacturers varied in qualitative and quantitative composition of tocopherols. Diverse composition of the oils affects the biological value of oil, expressed as equivalents of vitamin E.

53. Agnieszka Rękas[1], Małgorzata Wroniak[1], Aleksander Siger[2], Iwona Ścibisz[1]
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The effect of rapeseed pretreatment by microwaves on the content of phenolic compounds in the extracted oil

Phenolic acids constitute the major phenolics present in rapeseed, existing mainly in esterified form (80%), while about 15% are free phenolic acids. Because of their hydrophilic nature, only small proportion of phenolic acids is transferred to the oil. Using

microwave irradiation it is possible to achieve rapid and uniform heating of rapeseeds. It has been well documented that microwaves destroy biological cell structure in oilseeds resulting in better extractability of bio-active components, such tocopherols, phytosterols, and phenolics.

Rapeseeds were adjusted to moisture content of 7.5% and treated with microwaves under 800 W for 0, 2, 4, 6, 8, and 10 min and oil was cold-pressed, to investigate the effect of rapeseed pretreatment by microwaves on the content of phenolic compounds in theseeds and extracted oil. Changes in the content of phenolics in seeds and oil were assessed by determining the content of phenolic compounds by HPLC-DAD, including canolol determination by semi-preparative HPLC.

Based on these results, it can be concluded that differences in polarity and molecular structure and thus solubility in the oil is the main factor influencing transfer ratio of phenolic compounds into the crude oil. The main phenolic compound in rapeseed was sinapine, while the major phenolic compound found in rapeseed oil was canolol. Thermally-induced compositional changes were seen mainly in the content of canolol (lipophilic phenolic-type compound), while only slight alterations in the content of hydrophilic phenolics was observed. The most pronounced effect of seeds microwave pretreatment was noted for canolol formation, whose quantity after 10-min MV exposure increased from 6.16 to 129.21 mg/100 g in the oil, and from 5.35 to 118.46 mg/100 g DM in the seeds. Despite a small amount of phenolics detected in rapeseed oil, a clear trend can be observed: while the concentration of canolol in the oil increased with seeds MV exposure time elongation, the content of *trans*-sinapic acid in the oil significantly decreased ($p < 0.05$). Sinapic acid, under the conditions of elevated temperature undergoes structural changes which result in formation of canolol, as well as of syringaldehyde (3,5-dimethoxy-4-hydroxybenzaldehyde), which may explain decreased amount of this compound detected in the oil with increasing MV time. On the other hand, with increasing MV pretreatment time the quantities of sinapine, sinapic acid methyl ester, ferulic acid and *p*-coumaric acid in the oil were found, in general, to increase.

Key words: microwave pretreatment, rapeseed, phenolic compounds, canolol.

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The possibility of using natural and synthetic polyphenols to stabilize of phytosterols from rapeseed oil

The aim of the study was to evaluate the possibility of using plant extracts to stabilize the phytosterols in rapeseed oil during frying and compare their activity with synthetic antioxidants.

The study analyzed changes in the content of phytosterols in the partially hydrogenated rapeseed oil without antioxidants added and with the addition of rapeseed meal extract, rosemary extract, green tea extract, BHT and sinapic acid. The different types of oil were used as a heating medium during the model frying of commercially French fries available in local market (frozen French fries). Frying process was done at 170°C ± 10°C, in two fryers (3.5 liters capacity) which were of two replicates of the same sample. Frying has

continued in 15-minute cycles (four minutes deep-frying and 11 minutes heating of oil), and was carried out for 8 hours per day for 5 consecutive days (total of 40 hours of frying). During one cycle 100 g of product were fried. The oil sample (200 ml) was collected every day, after 8 h of frying, closed in plastic containers under nitrogen and stored at -24°C until the analysis. The content of phytosterols was determined by gas chromatography technique (GC). Individual phytosterols were identified to compare with the retention times of commercially available standards.

The content of phytosterols in fresh, unheated oil was high (4.79 mg/g of oil). The main phytosterols in fresh oil were β-sitosterol (46%) and campesterol (36%). Brassicasterol, avenasterol and stigmasterol were respectively 12%, 3.2% and 1% of the total content of phytosterols. During the frying process a steady decrease in the content of phytosterols in all samples of oil were observed but it depended on the used addition. The lowest decrease of total phytosterols (21.25%) was observed in oil with the addition of an ethanolic extract from green tea leaves. Losses of phytosterols in oil with the addition of the extract obtained from the rapeseed meal were slightly higher and amounted to 24.5%. In other oils with the addition of antioxidants phytosterols losses ranged from 26.44% for the oil with the addition of sinapic acid to 27% in oil with the addition of rosemary extract and BHT. The highest loss of phytosterols during frying was observed in the oil without the addition (30%). In most of the analyzed samples the largest loss of avenasterol, barssicasterol and stigmasterol was observed. The lowest loss of content of phytosterols in all samples was characteristic for β-sitosterol.

55. Iwona Bartkowiak-Broda[1], Magdalena Rudzińska[2], Elżbieta Radziejewska-Kubzdela[2], Teresa Piętka[1], Krzysztof Michalski[1], Maria Ogrodowczyk[1]
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Oil of white mustard (*Sinapis alba* L.) a rich source of phytosterols

Researches on white mustard quality traits are conducted in Plant Breeding and Acclimatization Institute over 30 years. The first achievement was variety without erucic acid in oil, Bamberka, licenced in 2006. The next step was the development of double improved variety Warta (licenced in 2011), characterized by very low erucic acid content in oil (below 1.5%), lack of sinalbin – the main glucosinolate in seeds of white mustard and very low content of other glucosinolates (below 15 μM/g of seeds). Novadays, the aim of investigations is the development of double low variety with very high content of anti-oxidants in oil. The qualitative and quantitative composition of phytosterols: brassicasterol, campesterol, sitosterol, sitostanol, δ5-avenasterol, δ7-avenasterol was studied in seed oil of 100 double low white mustard lines using gas chromatography. With the use of HPLC was evaluated content of carotenoid – lutein. The highest variability was found in the case of campesterol and sitosterol. The investigated lines displayed very high variability in the total content of phytosterols in the range 2473–17462 μg/g of oil. In the case of lutein the variability in the investigated material was very low. The obtained results indicated the possibility of development of white mustard with very high content of phytosterols in oil which will be characterized by high oxidative stability and very valuable for human dietary needs.

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