The Process Parameters for Non-Typical Seeds During Simulated Cold Deep Oil Expression

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Abstract

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We have determined the parameters of oil expression process for non-typical seeds of oil-producing plants, such as quince tree, safflower, fennel-flower, cuckoo-flower, tarweed, lallemantia, sea-buckthorn, borage, evening primrose, mustard, and others. The relative moisture of most of the seeds tested ranged from 5.5% to 8.9%. The values of the oil point pressure obtained for the seeds permitted detailed classification of the plant species under study into 7 seed hardness groups. The largest group belonged to the pressure range from 10 to 15 MPa (oil flax, spring rapeseed cvs Bronowski, Mazowiecki, and Star, spring rape cv. Porkland and local population, oil radish, spring camelina, mustard cv. Małopolska, evening primrose cv. UWM). The oil content in this group was above 30%, and in the case of rapeseed cv. Mazowiecki and Bronowski it was 40%. The values of compression energy obtained for the materials studied in the oil test ranged from 3.69 J (oil sunflower cv. Wielkopolski) to 64.18 J (sea-buckthorn).

Keywords: oil seeds; fat content; cold expression; oil-point

In recent years, an increase has been observed in consumers interest in natural products rich in biocomponents (Kris-Etherton *et al.* 2002). Among the oil plants, olives are particularly popular as their oil can be extracted in large quantities and is considered to be very beneficial to human health. Olive oil is obtained by cold pressing and is rich in biologically active substances (tocochromanols, phytosterols, carotenoids, phenolic compounds) (Matthaus *et al.* 2003; Schwartz *et al.* 2008; Siger & Nogala-Kałucka 2008). Oils like olive oil, produced by cold expression, are becoming increasingly popular on the European market. Oils available in Poland include rapeseed oil, sunflower oil, soybean oil, sesame seed oil, maize seed oil, peanut oil, grape seed oil, and pumpkin seed oil (Axtell & Fairman 1992; Bail *et al.* 2008). Cold expression technology is ecological, simple, and does not require a large expenditure of energy, but the efficiency of the process is lower than that of expression-extraction technology, as 6–15% of the oil remains in the oilcake. The cold press method was also used by Enweremadu and Alamu (2010) for extracting the shea nut butter from shea nut for obtaining biodiesel. Oil plant seeds used for the production of oil by cold expression must be ripe, undamaged, and properly stored, otherwise the quality of the oil produced will be reduced (Rusinek *et al.* 2008; Kasprzycka *et al.* 2010).

Cold-pressed oils are rich in natural antioxidants and pro-vitamins which are highly important from the viewpoint of nutrition as they represent metabolic components that are not synthesised by the human organism but are necessary for the healthy functioning of the body (Lecker & Rodriguez-Estrada 2000; Goffman & Galletti 2001; Nogala-Kałucka *et al.* 2008). They are also among the fundamental and important components of the daily human diet due to their contents of unsaturated fatty acids (Kato *et al.* 2002). A diet rich in specific fatty acids plays an important role in human physiology, e.g. unsaturated acids from the omega-3 group are highly significant in the prophylaxis of neoplastic diseases, cardiovascular disorders, and diseases of the immune system (Ezaki *et al.* 1999; Ihara-Watanabe *et al.* 2000; Kris-Etherton *et al.* 2002; Berger 2007). Native antioxidants also protect the polyenic fatty acids against oxidation, thus improving the shelf-life of oils (Ruth *at al.* 2001; Koski *at al.* 2002; Siger *at al.* 2008), and essential (volatile) oils from different plants have the potential of food preservatives (Celikel & Kavas 2008). The oxidative stability of unrefined oils (pumpkin seed and extra virgin olive oils) is better than that of refined oils, thus the unrefined oils have a longer hypothetical stability and are more suitable for frying (Vidrih *et al.* 2010).

The contents of tocopherols, sterols, carotenoids, phospholipids, and phenolic compounds in cold-pressed oils are higher than those in refined oils from which these compounds are partially or totally eliminated. In spite of the advances in technology, the loss of biologically active compounds during the procedure of oil refining is still significant (O'Brien 2008; Vidrih *et al.* 2010). It is also significant that the cold-pressed oils do not contain any of the isomers of *trans* fatty acids which are formed in refined oils as a result of the drastic process parameters, especially the temperature used for the deodorisation process. On the other hand, complete hydrogenation of a liquid vegetable oil will result in a fat of high melting point with zero *trans* fatty acids. In practice it can be used in food fats after interesterification with a soft oil (Berger 2007).

Due to the absence of uniform legislation regulating the contents of individual components, and especially of undesirable contaminants, the production of cold-pressed oils may justifiably raise concerns. Such reservations are related mainly to the microbiological purity of the oils, and to the contents of metal residues and plant protection agents. However, proper quality control of the oils produced includes close monitoring of the quality of the raw materials used, thus precluding products of insufficient quality from being released onto the market (Matthaus & Bruhl 2003).

At present, the increasing supply of vegetable fats and oils has led to increased competitiveness within this range of products. Numerous research projects have been undertaken in the search for new, alternative oil plants that not only have a suitable fatty acid composition but also contain biologically active components, among which vitamin E-active compounds are of particular importance. The positive effect of vitamin E taken in the form of supplements is notably lower than that resulting from the consumption of natural healthy food. This has caused a trend towards the return, not only in the food industry but also in the cosmetics and pharmaceutical industries (Rabasco Alvarez & González Rodríguez 2000; Lautenschlager 2004; Nogala-Kałucka *et al.* 2008), to the utilisation of the valuable components of long-forgotten plants such as camelina, evening primrose, borage, safflower, etc. (Barre 2001). It is plants of this type, i.e. those that used to be grown in Poland (e.g. spring varieties of rapeseed and rape, flax, camelina, etc.) as well as non-typical plants such as the quince tree, safflower, fennel-flower, *Lallemantia iberica*, cuckoo-flower, tarweed, etc., that are the reason for undertaking the study which is concerned with the determination of oil expression parameters, the so-called oil point. This type of information will surely be useful and important for the determination of which of the seeds may be a useful source of oil, and which can be used to yield oil by cold expression.

The research in the field of "cold expression" has been conducted for some time, due to the practical importance of the subject. The classical theory of oil expression assumes that during the process the cell walls are ruptured and oil migrates beyond the cell area and is filtered through the seed deposit (Khan & Hanna 1985). The oil is bound to the skeleton of the tissue and this process requires a specific amount of energy. Under normal conditions, when seeds are not subjected to any external pressure, oil does not migrate outside of the seed. During the seed compression, part of the load applied affects the skeleton of the tissue which then undergoes deformation, and the remainder of the applied force is exerted on the oil in the tissue. The pressure increase in the deformed tissue causes rupture of the forces of adhesion and surface tension, and at the same time any oil that has already been expressed gains mobility and may migrate to other areas of the porous medium. Oil outflow outside the walls of the seed is the manifestation of the oil-point having been reached.

The relationship between the oil point pressure and seed moisture was determined among others by Sukumaran and Singh (1989), who also studied the effect of the rate of rapeseed compression. Tys *et al.* (2002) studied the effects of the drying temperature and seed moisture on the oil point pressure. Their studies showed that with an increase in drying temperature, the value of the oil-point pressure decreased from 11.6 MPa at 20°C to 5.6 MPa at 150°C. An increase in seed moisture caused an increase in the oil point pressure. In both cases, there was a decrease in the energy used for the sample compression. Faborode and Favier (1996) conducted a series of experiments investigating the oil-points of several oil seed species. They determined, among other things, the density, energy, and relative deformation of the materials at the oil-point. Based on these experiments, the authors classified the materials tested as soft seeds and hard seeds.

The objective of this study was the determination of the oil-point parameters of non-typical oil materials and of seeds commonly used in the oil-producing industry (in Poland – mainly rapeseed) and the classification of those oil materials in terms of their oil-yielding capacity in relation to the oil content of their seeds and to the seed moisture. We investigated the process of cold deep expression, using a cylinder designed specifically for this purpose. The process parameters we applied corresponded with those employed in oil expression in industrial installations.

MATERIAL AND METHODS

Materials. Some of the seeds used in this study originated from the Faculty of Soil and Plant Cultivation, Poznan University of Life Sciences, and others were obtained by courtesy of the Faculty of Processing and Chemistry of Plant Materials, Warmia and Mazury University in Olsztyn. The study included seeds from the following oil plants: safflower (*Carthamus tinctorius* L.) (cv. Barwierski, P I and P II), blueweed (*Echium vulgare*), quince tree (*Cydonia vulgaris*), evening primrose (*Oenothera biennis*), briar-rose (*Rosa mosqueta*), fennel-flower (*Nigella sativa*), sea-buckthorn (*Hippophae rhamnoides*), borage (*Borago officinalis*), spring camelina (*Camelina sativa* L.), oil flax (*Linum usitatissimum* L.), tarweed (*Madia sativa* L), spring rapeseed (*Brassica napus* L.) (cv. Bronowski, Mazowiecki, Star), spring rape (*Brassica campestris oleifera*) (local population and cv. Parkland), Crambe abyssinica (*Crambe abyssinica*), lallemantia (*Lallemantia iberica*), white mustard (*Sinapis alba*) (cv. Borowska, Metex, Nakielska), mustard (*Brassica juncea*) (cv. Małopolska), oil sunflower (*Helianthus annuus* L.), cuckoo-flower (*Lepidium sativum* L.), oil radish (*Raphanus sativus oleiformis*). The research material was not subjected to any additional treatment and was used in the form that is encountered in commercial and industrial applications.

Determination of oilseed moisture *(Standard PN-EN ISO 665).* A dish containing fragmented seeds in amounts of 2.000 ± 0.002 g was placed in a dryer at a temperature of 105 ± 2°C. The process of drying was continued until constant weight was obtained.

Determination of fat content using a Soxtec apparatus. Prior to the extraction, the seeds were ground and dried in thimbles at a temperature of 105 ± 2°C. After cooling, they were weighed again with the accuracy of 0.001g and placed in the Soxtec apparatus. The extraction cups containing 50 ml of solvent were placed on a heating plate and the process of extraction was initiated. The determination of seed oil content was performed by extraction of the fat substances from the sample using petroleum ether. When the process of extraction was complete, the extraction cups were placed in a dryer for 1 h at 105 ± 2°C, then transferred to an exsiccator for 1 h, and weighed at an accuracy of 0.001 gram.

The oil-point test. The oil-point tests were carried out in accordance with the procedure developed by Sukumaran and Singh (1989) and Fornal *et al.* (1994), in a metal cylinder of 1.3 cm diameter, placed in a strength tester. To ensure high repeatability of the tests, the cylinder was filled with seeds to a volume of 1 cm^3 by means of a specially calibrated vessel. At the bottom of the cylinder was a small slot that permitted free outflow of oil onto blotting paper. The piston moved at constant rate of 20 mm/min; as soon as oil appeared on the blotting paper the beam of the strength tester was stopped (Figure 1). The pressure exerted by the piston on the sample at the first appearance of oil on the blotting paper was defined as the oil-point (Figure 2). The oil-

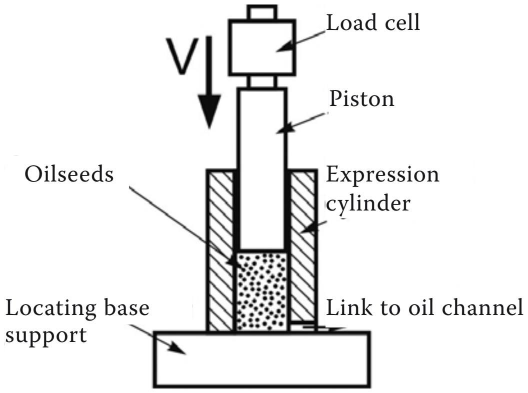

Figure 1. Oil expression measuring instrument for monitoring of oil pressure

point referred to in this report is defined as the minimum pressure required for the oil contained in the seeds to flow out of the cylinder. The course of the force values in time was recorded by a PC coupled to the strength tester. For each variant of the experiment, ten replications were carried out; the observed errors were rejected at the test stage and replaced with another replication of the experiment. The mean temperature at which the tests were conducted was 20°C.

RESULTS AND DISCUSSION

Table 1 shows the values of particular oil point parameters (oil point pressure, compression energy, and relative displacement) as well as the contents of water and oil in the materials tested. In terms of the oil content of the seeds and the level of piston pressure at the oil point, the seeds tested can be classified as low- and high-oil and as soft and hard. A similar classification was adopted by Faborode and Favier (1996) who classified seeds with an oil content of more than 25% as high-oil seeds. According to the classification of these authors, soft oil seeds were those whose compression energy was lower than 40 kJ/kg, and the pressure that characterised soft seeds was ~ 10 MPa or less.

Among the materials tested, briar-rose and Spanish colewort seeds did not display any tendency to yield oil within the range of pressures applied (up to 100 MPa), even though, according to the classification mentioned above, the oil content in these samples places them into the category of high-oil plants (above 25%) (Faborode & Favier 1996). This was most probably related to the different structure of the seeds in which, unlike in the other materials, oil is bound more strongly to the inner part of the seed, while the seed cover forms a stronger barrier to oil migration out of the seed.

In the case of sea-buckthorn seeds, the low oil content (12.10%) had a direct bearing on the high oil point pressure (96.73 MPa) and compression energy (64.18 J). Similar values were obtained for quince tree seeds (97.72 MPa and 55.41 J), although in this case the oil content was twice (25.27%) that of sea-buckthorn. The lowest values of pressure were obtained for seeds of borage (7.57 MPa), sunflower (5.94 MPa), and tarweed (8.21 MPa). The oil point pressure of melon seed oil under different processing conditions (moisture content, heating temperature, and time) obtained by Tunde-Akintunde (2010) was lower and ranged from 0.84 MPa to 2.05 MPa, and Ogunsina *et al.* (2008) reported that this point for coarsely ground and finely ground cashew kernel aggregates reached the values from 0.16 MPa to 0.29 MPa. Within the entire group of seeds, these were the most susceptible to the oil expression. A particularly strong tendency towards the oil expression was displayed by sunflower – the energy required to reach the oil-point was as low as 3.69 J.

The largest group of seeds among the 27 samples contained those seeds for which the oil point pressure was close to the upper limit for soft seeds (10 MPa). This group included all spring rapeseed cultivars and mustard, oil radish, camelina, evening primrose, and oil flax. The oil content in this group was above 30%, and in the case of rapeseed cvs Mazowiecki and Bronowski it was 40%. The other group of seeds included those in which the oil-

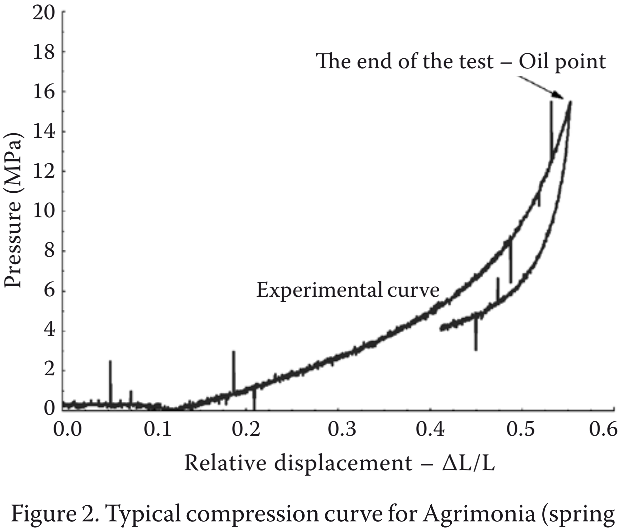

Figure 2. Typical compression curve for Agrimonia (spring population)

Table 1. Mean values (± SD) of oil point pressure, compression energy, relative displacement, moisture content, and oil content of the materials tested

Materials	Moisture content (%, w.b.)	Fat content (%)	Oil point pressure (MPa)	Compression energy (J)	Relative displacement
1 Spring rape (*Brassica campestris oleifera*), local	5.88 ± 0.02	35.43 ± 0.53	12.57 ± 0.40	7.53 ± 0.34	0.50 ± 0.01
2 Spring rapeseed (*Brassica napus* L.) cv. Mazowiecki	5.50 ± 0.03	41.20 ± 0.78	11.66 ± 0.31	7.13 ± 0.24	0.51 ± 0.01
3 Spring rapeseed (*Brassica napus* L.) cv. Bronowski	5.50 ± 0.06	40.00 ± 0.88	11.22 ± 0.49	6.68 ± 0.39	0.50 ± 0.01
4 Spring rapeseed (*Brassica napus* L.) cv. Star	5.82 ± 0.06	39.50 ± 0.16	11.47 ± 0.32	7.03 ± 0.26	0.51 ± 0.02
5 Spring rape (*Brassica campestris oleifera*) cv. Parkland	5.46 ± 0.03	35.30 ± 0.58	11.52 ± 0.29	7.04 ± 0.20	0.51 ± 0.01
6 Mustard (*Brassica juncea*) cv. Małopolska	5.92 ± 0.02	31.14 ± 0.44	13.95 ± 0.32	8.56 ± 0.45	0.51 ± 0.02
7 White mustard (*Sinapis alba*) cv. Borowska	6.14 ± 0.00	32.90 ± 0.92	23.39 ± 0.77	14.47 ± 0.66	0.52 ± 0.02
8 White mustard (*Sinapis alba*) cv. Nakielska	6.28 ± 0.01	30.40 ± 0.66	22.73 ± 1.81	13.99 ± 1.47	0.51 ± 0.02
9 White mustard (*Sinapis alba*) cv. Metex	6.35 ± 0.05	25.30 ± 0.07	23.56 ± 1.26	15.07 ± 0.95	0.53 ± 0.03
10 Oil radish (*Raphanus sativus oleiformis*)	5.88 ± 0.01	33.14 ± 0.80	11.65 ± 0.32	7.70 ± 0.54	0.55 ± 0.03
11 Spring camelina (*Camelina sativa* L.)	6.40 ± 0.01	33.92 ± 0.75	13.81 ± 0.30	8.32 ± 0.05	0.50 ± 0.01
12 Evening primrose (*Oenothera biennis*) cv. UWM	8.02 ± 0.01	30.0 ± 0.30	14.71 ± 0.66	11.19 ± 1.41	0.63 ± 0.05
13 Borage (*Borago officinalis*)	7.99 ± 0.08	35.58 ± 0.08	7.57 ± 0.82	4.78 ± 1.12	0.52 ± 0.07
14 Sea-buckthorn (*Hippophae rhamnoides*)	7.00 ± 0.01	12.10 ± 0.22	96.73 ± 1.22	64.18 ± 1.79	0.56 ± 0.01
15 Briar-rose (*Rosa mosqueta*)	6.72 ± 0.02	51.95 ± 0.15	without flow		
16 Quince tree (*Cydonia vulgaris*)	15.61±0.02	25.27 ± 0.34	97.72 ± 0.50	55.41 ± 0.77	0.47 ± 0.01
17 Safflower (*Carthamus tinctorius* L.) P I	8.16 ± 0.00	26.47 ± 0.17	28.34 ± 2.58	19.71 ± 3.23	0.58 ± 0.05
18 Safflower (*Carthamus tinctorius* L.) P II	8.90 ± 0.02	25.58 ± 0.92	26.72 ± 1.52	20.30 ± 2.07	0.63 ± 0.03
19 Safflower (*Carthamus tinctorius* L.) cv. Barwierski	6.16 ± 0.03	31.25 ± 0.04	18.97 ± 0.55	12.87 ± 0.21	0.57 ± 0.01
20 Oil flax (*Linum usitatissimum* L.)	6.04 ± 0.00	36.75 ± 0.26	10.29 ± 0.11	5.64 ± 0.58	0.46 ± 0.04
21 Fennel-flower (*Nigella sativa*)	6.94 ± 0.03	23.0 ± 0.75	30.12 ± 2.74	21.48 ± 2.15	0.59 ± 0.02
22 Oil sunflower (*Helianthus annuus* L.), cv. Wielkopolski	3.80 ± 0.03	47.20 ± 0.53	5.94 ± 0.59	3.69 ± 0.90	0.52 ± 0.11
23 Cuckoo-flower (*Lepidium sativum* L.)	7.99 ± 0.04	23.0 ± 0.75	43.66 ± 1.67	26.37 ± 1.17	0.50 ± 0.01
24 Spanish colewort (*Crambe abysinica*)	6.54 ± 0.04	29.13 ± 3.55	without flow		
25 Lallemantia (*Lallemantia iberica*)	6.14 ± 0.04	30.50 ± 0.56	16.70 ± 0.57	11.13 ± 0.89	0.55 ± 0.03
26 Tarweed (*Madia sativa* L.)	4.05 ± 0.02	37.06 ± 0.26	8.21 ± 0.68	5.74 ± 0.58	0.58 ± 0.02
27 Blueweed (*Echium vulgare*)	7.95 ± 0.05	27.40 ± 0.10	16.70 ± 0.47	11.53 ± 1.06	0.58 ± 0.05

point was within the range of 16 MPa to 28 MPa and the oil content ranged from 25% to 32%. This group consisted of seeds of white mustard cultivars, safflower, lallemantia, and blueweed.

Among the parameters considered with regard to the cold expression of oil, the oil point pressure and energy provided the most information relevant to the oil yield of the seeds. The relative displacement of the piston was a parameter that gave the least information about the process and the materials. The variability of this parameter was not unequivocally related to either the hardness or the oil content of the seed. A lack of variation in this parameter was observed with the seeds of spring rapeseed, the relative displacement of the piston in this group of materials being 0.50–0.51.

Literature data as well as the data provided by the manufacturers of presses for oil expression indicate that the oil yield decreases with increasing seed moisture (Fornal *et al.* 1994; Tys *et al.* 2002;

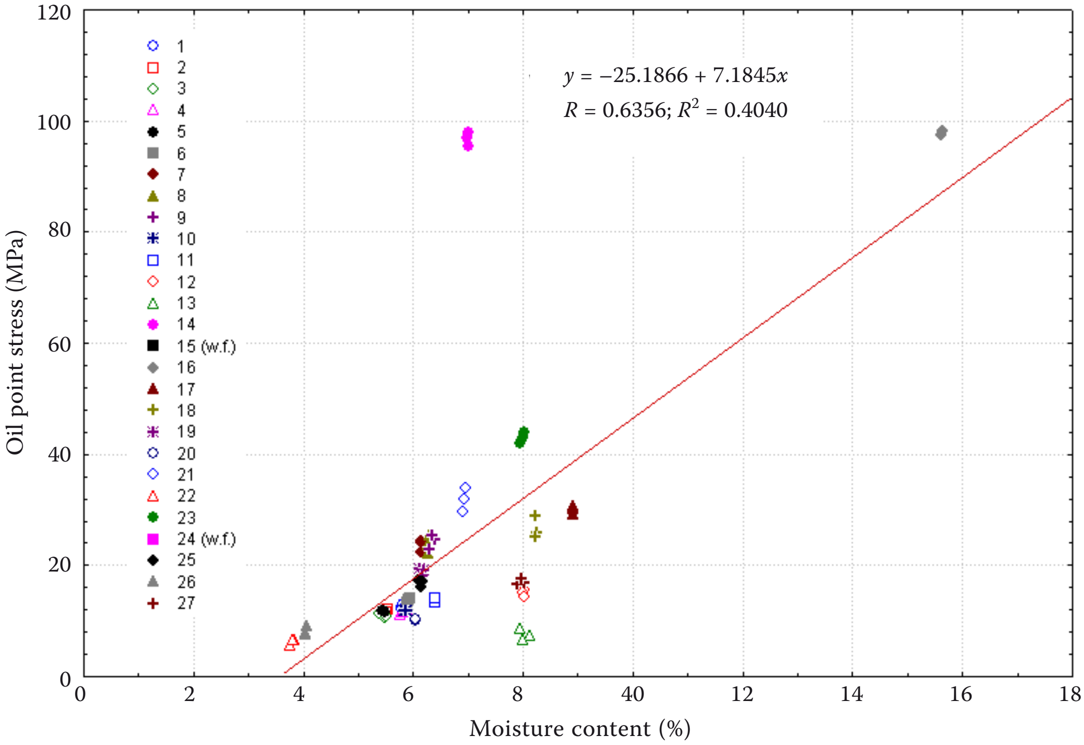

Figure 3. Plot of oil point pressure versus moisture content for the materials tested (No. 1–27 represents materials arranged at Table 1)

Matthäus & Bruhl 2003; Ogunsina *et al.* 2008; Rusinek *et al.* 2008; Tunde-Akintunde 2010). The study presented here does not provide any clear-cut support for this relationship as there is a lack of research into the effect of moisture within a single species of seeds; however, our analysis indicates a certain degree of similarity (Figure 3). For this reason, additional oil-point tests were carried out with rape seeds of cv. Licosmos at three levels of moisture – 6, 9, and 13% (w.b.). An increase in the seed moisture caused an increase in the pressure at the oil point, as follows: 6% – 11.6 MPa, 9% – 13.2 MPa, 13% – 20.5 MPa. During that time, the relative deformation decreased slightly, from 0.48% at 6% to 0.43% at 13%, while the amount of energy required decreased approximately three-fold, from 2.4 J to 0.9 J. These results suggest that the water contained in the seeds inhibits the oil outflow from the plant tissues by increasing the pressure at the oil-point and, on the other hand, reduces the amount of energy used for the sample compression. During the oil expression process, the presence of moisture in the oilseed cushions the effect of the pressure application as a result of mucilage development, such that more pressure will be required in oilseeds of high moisture content for the compression of the seed. This is because part of the applied pressure will be used to overcome the cushioning effect before the oilseed can be compressed and the oil forced out of the cells (Owolarafe *et al.* 2003; Tunde-Akintunde 2010). With an increase in the oil content in the seeds, there was an increase in their capacity for oil expression. The seeds of sea-buckthorn and quince tree were exceptions, but if these results were omitted, the coefficient of determination (Figure 4) would be close to one. The relationship presented indicates that the oil-expression capacity of a material is affected not only by the percentage content of oil in the seed but also by the structure of the seed and the manner in which the oil binds to the tissue.

Among the plant species under study, only the seeds of quince tree were characterised by moisture levels of 15%; the relative moisture of most of the seeds tested fell into the range of 5.5% to 8.9%, with the exception of oil sunflower cv. Wielkopolski (3.8%) and tarweed (4.1%). In connection with the low seed-moisture in the case of oil production from sunflower cv. Wielkopolski and tarweed (seeds of plants from the high-oil group) could be the low values of oil point pressure of 5.94 MPa and 8.21 MPa, respectively. A similar range of

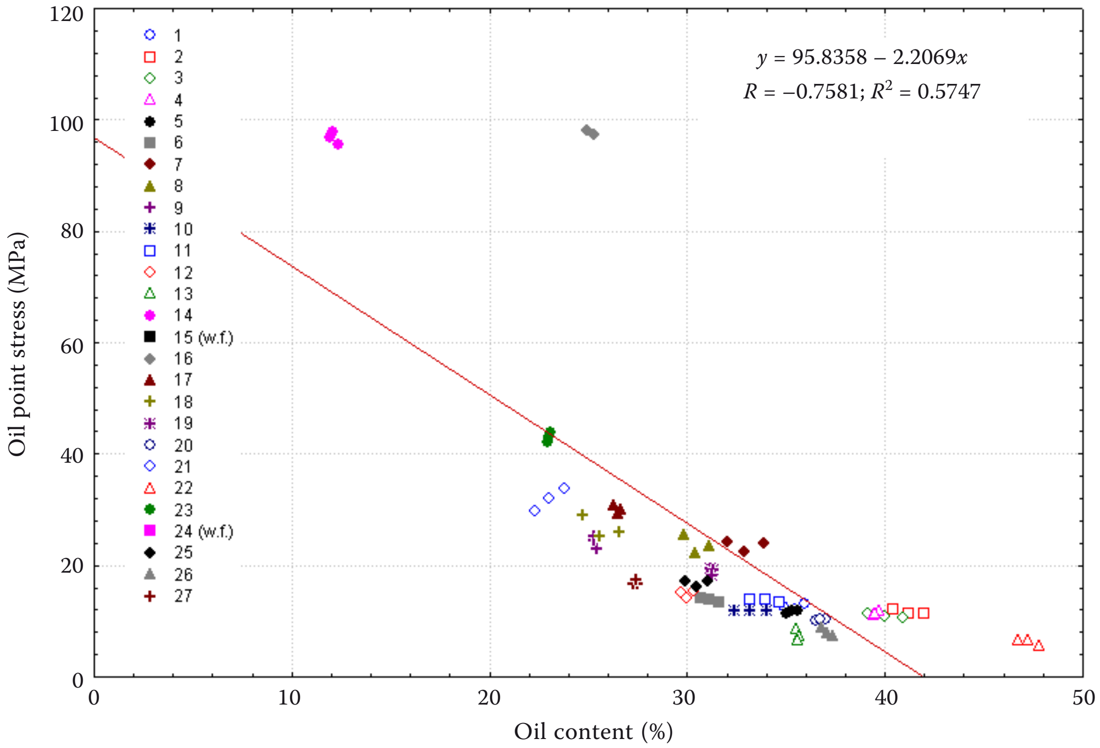

Figure 4. Plot of oil point pressure versus oil content for the materials tested (No. 1–27 represents materials arranged at Table 1)

the oil point pressure values was observed in the case of borage seeds (7.75 MPa) which have a moisture content of ~ 8%. The highest level of the pressure values was noted at the oil-point of sea-buckthorn seeds (96.73 MPa) and quince tree seeds (97.72 MPa) whose levels of the seed moisture are 7.0% and 15.61%, respectively.

The values of the oil point pressure obtained for the seeds permitted the detailed classification of the plant species under study into 7 seed hardness groups:

> 10 MPa – oil sunflower cv. Wielkopolski, borage and tarweed –3 species;
10–15 MPa – oil flax, spring rapeseed cv. Bronowski, spring rapeseed cvs Star and Mazowiecki, spring rape cv. Porkland and local population, oil radish, spring camelina, mustard cv. Małopolska, evening primrose cv. UWM – 10 species;
15–20 MPa – blueweed, lallemantia, safflower cv. Braniewski – 3 species;
20–25 MPa – white mustard cvs Nakielska, Borowska, and Metex – 3 species;
25–30 MPa – safflower P II and P I – 2 species;
30–50 MPa – fennel-flower, sowing cuckoo-flower – 2 species;
50–100 MPa – sea-buckthorn, quince tree – 2 species.

The values of the relative displacement obtained in the oil test fell within the range of 0.5 to 0.6, with the exception of seeds of oil flax (0.46), quince tree (0.47), and safflower P II (0.63).

The seeds of the plant species under study were characterised by considerable differences between their oil contents. In accordance with the classification proposed by Faborode and Favier (1996), they can be classified as high-oil plants: lallemantia, white rapeseed cvs Nakielska, Borowska, and Metex, rape cv. Serepska Małopolska, safflower cvs Braniewski, P II, and P I, oil flax, spring camelina, tarweed, borage, quince tree, oil sunflower cv. Wielkopolski, spring rapeseed cvs Bronowski, Star, Porkland, and Mazowiecki, spring rape local population, oil radish, blueweed, and evening primrose cv. UWM; and low-oil plants: fennel-flower, sea-buckthorn, and cuckoo-flower.

CONCLUSION

From the practical point of view, the knowledge of the oil point values is important for two reasons. First, it is important in storage, as in silos oil outflow from seeds may occur due to the pressure exerted by the upper layers of seed, and to inadequate storage conditions or seed parameters (seed moisture, temperature). The second important issue that has recently raised considerable interest is oil expression in presses which, due to their ecological character, are the focus of interest of the oil-producing companies. The oil point test defines the minimum pressure that is necessary to cause oil outflow from the seeds. Generally, the value of the oil point depends on the oil content of the seed and the structure and moisture level of the raw material. The results of this study have revealed a deviation from this rule: despite their similarities in the oil contents, the seeds tested in this study differed in their capacity to express oil. In two cases no effect of oil content was observed, and the remaining seed species were classified in terms of their oil-yielding capacity. Ten seed species (the largest group) were classified within the oil point pressure range of 10 MPa to 15 MPa. This group includes the most popular oil seeds used by the oil-producing industry in Poland (rapeseed, rape, mustard) and can be treated as a reference for other seeds in terms of the possibility of oil expression in presses commonly used by the oil industry. The materials with oil point values much higher than those of the reference group cannot be processed on an industrial scale without some modifications of the technology in the existing process lines (e.g. change of process temperature or increase of expression pressure).

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