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THE LIPID CONTENT IN THE SEEDS OF BRASSICACEAE BURNETT FAMILY

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The goal of this paper is to demonstrate a potential of energetic value of seeds of oil plants collected in the M.M. Gryshko National Botanical Garden of the NAS of Ukraine. In the present study lipid and caloric content of cultivars and varieties of *Brassica campestris* D.C., *Brassica junceae* (L.) Czern., *Brassica napus* D.C., *Brassica rapa* subsp. rapifera Metzger, *Camelina sativa* (L.) Crantz and *Sinapis alba* L. are described. Studing of seeds of 19 samples of investigated plants was carried out by method of extraction with petroleum ether equipped with Soxhlet extractor. Content of lipids was determined in range from 17.72% (*Brassica campestris* f. *annua* D.C., cv. Pioner) to 37.61% (*Brassica napus* f. *annua* D.C., cv.s. Yamal). Comparing of *Brassica campestris* plants showed that winter varieties had higher level of lipids in seeds and was in range from 28.35 to 34.48%. In the spring varieties the same parameter was in range from 17.72 to 29.00%. Identification of energetic value was made by method of combustion in the oxygen and was determined in range from 5,039.33 Kcal/kg (*Brassica campestris* f. *annua*) to 6,108.00 Kcal/kg (*Brassica napus* f. *annua* D.C., cv.s. Yamal). Content of calories in the seeds of winter varieties of *Brassica campestris* was from 5,530.40 to 6,045.67 Kcal/kg and in spring varieties – from 5,381.33 to 5,659.11 Kcal/kg.

Keywords: oil plants; lipids; energetic value

Introduction

Among the important direction of biofuel production in Ukraine is finding plants with high content of oils. Brassicaceae Burnett is one of the most widespread families which members have provided substantial part of human needs in plant oil. These cultures have the high ecological plasticity, productive potential, resistance to pests etc. Among these plants species of genus of *Brassica* L., *Camelina* L., *Sinapis* L. should be noted (Chhokar et al., 2008; Baud and Lepiniec, 2010; Rakhmetov et al., 2014; Beniwal et al., 2015).

The cultivated *Brassica* species are the group of economically important crops for human health, nutrition as well as for non-edible uses. The oil of some species is a rich source of fatty acids which use nowadays (Dasgupta and Friend, 1973; Sharma et al., 2003; Qui et al., 2006; El-Beltagi and Mohamed, 2010; Pieretti et al., 2012). Many of them accumulate fatty acids in the form of triacylglycerols as major storage components in seeds (Li et al., 2006; Chhokar et al., 2008). High content of linoleic and linolenic acid was found in seeds of *Camelina sativa* L. (Shukla et al., 2002).

One of the most important purpose in the agricultural science is to find a new source of oil that is rich by fatty acids. Also, last time many investigations have connected with determination

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of energetic value of different parts of plants and influence of adding of mineral fertilization (Nurzynska-Wierdak, 2015). There are suggestions that waste vegetable oil would be the best source to produce biodiesel. Although it has economic benefits, it is even more profitable to convert waste oils into other products, such as soap (Hodur et al., 2012).

Our aim was to determine a content of lipids and energetic potential of seeds some oil plants.

Materials and methodology

Plant material was collected from the experimental collections of the Department of Cultural flora of M.M. Gryshko National Botanical Garden of the NAS of Ukraine. The procedure of the determination of total lipid level was performed using Soxhlet extractor. Seeds were fixed in the filter paper packets with measured mass. The total lipids were extracted with petroleum ether (boiling temperature 40–60 °C) according to A.I. Yermakov. Total procedure of extraction was carried out for three days (Yermakov et al., 1972). To measure of caloric value of seeds was equipped with a calorimeter IKA C-200 (Germany). Dry seeds in a range from 0.1 to 0.2 g were put in the decomposition vessel (IKA C 5010/5012) that fills with medical oxygen. All operation of measuring of one sample is 15 minutes in the distilled water. Experimental data were evaluated by using Excel 2010.

Results and discussion

Lipids have many important biological functions, including storing energy, signaling and acting as structural components of cell membranes. These important biological macromolecules, occur in different forms such as waxes, sterols, fat-soluble vitamins, phospholipids etc. (Chen et al., 2015). Data given in table showed different oil content in the seeds of investigated plants (Table 1). Minimal level of lipids was found in the sample of *Brassica campestris* f. *annua* D.C., cv. Pioner and maximal – in the *Brassica napus* f. *annua* D.C., cv.s. Yamal. *Brassica napus* is one of the most important edible oilseed crops in the world and produces considerable amounts of edible oil for human consumption (Chen et al., 2015).

It is noticed that samples of seeds of *Brassica campestris* had a total content of lipids from 17.72 to 34.48%. If consider different varieties of *Brassica campestris* it should be noted that lipid content in seeds of spring varieties was from 17.72 to 29.04% and in winter-annual varieties – from 28.35 to 34.48%. According to Blume et al. (2016) maximal oil content in seed was up to 45.1% for *Brassica campestris* f. *biennis* D.C.× *B. rapa* L. that showed results more than in our experiment for investigated cultivars (32.27–34.48%) (Blume et al., 2016).

Energetic value of seeds was from 5,039.33 to 5,659.11 Kcal/kg in summer varieties and from 5,530.40 to 6,045.67 Kcal/kg in winter-annual varieties of plants of *Brassica campestris*.

Seeds of *Brassica junceae* showed total lipid content from 21.48 to 25.45%, *Brassica napus* – from 27.69 to 37.61%, *Brassica rapa* – 22.39%, *Sinapis alba* – 31.80%. Previous data, for example, Goffman et al. (1999) found 27.7, 40.6, 31.4 and 19.4% of lipid content in these samples respectively.

Brassica napus is the third most important source of vegetable oil in the world, after soybean and palm oil. Rapeseed oil is an excellent feedstock for biodiesel production (Hodur et al., 2012). Jensen et al. (1996) identified content of lipids in the *Brassica napus* seeds in range from 39.9 to 46.5% (Jensen et al., 1996). Two our samples of *Brassica napus* showed lipid concentration 27.69–37.61%.

Table 1 The total content of lipids and energetic value of seeds Brassicaceae Burnett family

Name of sample	Lipids, %	Energetic value, Kcal/kg
***Brassica campestris* f. *annua* D.C.**	20.81 ±0.64	5,039.33 ±115.44
***B. campestris* f. *annua* D.C., cv.s. Chanita-FLO**	25.27 ±0.85	5,659.11 ±132.59
***B. campestris* f. *annua* D.C., cv. Pioner**	17.72 ±0.68	5,381.33 ±113.54
***B. campestris* f. *annua* D.C., f. EOSIAF-1**	25.08 ±0.25	5,633.00 ±144.41
***B. campestris* f. *annua* D.C., f. EOSIAF-2**	29.04 ±0.85	5,645.33 ±131.86
***B. campestris* f. *biennis* D.C., cv. Oriana**	33.26 ±0.09	6,045.67 ±96.62
***B. campestris* f. *biennis* D.C., f. EOSOFHI**	33.92 ±0.01	5,981.33 ±104.52
***B. campestris* f. *biennis* D.C.× *B. rapa* L., cv. Fitopal**	32.57 ±0.15	5,939.67 ±104.62
***B. campestris* f. *biennis* D.C.× *B. rapa* L., cv. Obrii**	32.27 ±0.12	5,944.00 ±88.07
***B. campestris* f. *biennis* D.C.× *B. rapa* L., f. EOTFVS**	34.48 ±0.58	5,971.67 ±111.29
***B. campestris* f. *biennis* D.C.× *B. rapa* L. × *B. napus* f. *biennis* D.C., f. EOHBFTRO-1**	29.58 ±0.69	5,530.40 ±131.93
***B. campestris* f. *biennis* D.C. × *B. napus* f. *biennis* D.C., cv. Innovacia**	28.35 ±1.12	5,761.33 ±122.39
***B. junceae* (L.) Czern. f. *biennis*, cv. Annushka**	21.48 ±0.15	5,260.39 ±122.71
***B. junceae* (L.) Czern. f. *biennis*, cv. Venera**	25.45 ±0.60	5,472.33 ±126.51
***B. napus* f. *annua* D.C., cv.s. Yamal**	37.61 ±0.57	6,108.00 ±99.24
***B. napus* f. *biennis* D.C., f. EROF-5**	27.69 ±1.73	5,411.67 ±102.03
***B. rapa* subsp. rapifera Metzger**	22.39 ±2.17	5,653.00 ±82.93
Camelina sativa* (L.) Crantz f. *biennis	31.55 ±1.14	5,381.67 ±113.18
***Sinapis alba* L., cv. Karolina-B**	31.80 ±1.70	5,753.00 ±95.87

It was identified that lipid level in *Camelina sativa* was 31.55% that is similar to data obtained by Budin et al. (1995). In this report results determined in the range from 29.9 to 38.3% (Budin et al., 1995). According to data of Zubr (2003) this parameter was in range from 39.6 to 44.1% (Zubr, 2003). Basing on data obtained by Blume et al. (2016) the oil content of seeds of *Camelina sativa* identified in range from 42.6 to 43.9% that is 12% more approximately if compare with our results. Rakhmetov et al. (2014) reported that cultivars and varieties *Camelina sativa* seed had rich lipid value from 36.04 to 43.89% (Rakhmetov et al., 2014).

The average caloric value of all samples ranged from 5,039.33 Kcal/kg (*Brassica campestris* f. *annua*) to 6,108.00 Kcal/kg (*Brassica napus* f. *annua* D.C., cv.s. Yamal). Previous data obtained by Rakhmetov et al. (2014) showed high energy value of *Camelina sativa* seeds (5,678–5,965 Kcal/kg) (Rakhmetov et al., 2014). In our experiment, this parameter was 5,381.67 Kcal/kg.

Conclusions

In the conditions of M.M. Gryshko National Botanical Garden of the NAS of Ukraine the total content of lipids in the seeds of 19 investigated plant samples oil plants of Brassicaceae species was

in range from 17.72 (*Brassica campestris* f. *annua* D.C., cv. Pioner) to 37.61 (*Brassica napus* f. *annua* D.C., cv.s. Yamal) % per dry matter. Winter varieties of *Brassica campestris* had higher level of lipids than spring varieties. Also, was determined energetic value of seeds of these plants in range from 5,039.33 (*Brassica campestris* f. *annua*) to 6,108.00 (*Brassica napus* f. *annua* D.C., cv.s. Yamal). Our experimental data have showed that investigated species of plants and their cultivars and varieties are the rich source of lipids and caloric content for different directions of use.

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