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# A new technology for the production of valuable vitamin extracts from wheat and rye germs

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A method for nearly complete extraction of the lipid fraction from wheat and rye germs was developed, and the technological parameters of the production process were specified. The resulting preparations are extracts rich in vitamin E and other biologically active components. Dermatological studies and application in the cosmetic industry have testified to the suitability of these preparations for use in cosmetic and pharmaceutical products. Owing to their high content of unsaturated fatty acids and to a natural combination of biologically active compounds, the preparations from wheat and rye germs obtained by our method on an industrial scale find increasingly wider application. The post-extraction residue free from the lipid fraction is high-value feed.

Wheat and rye germs are obtained as a result of the milling process in amounts of 0.01 to 0.03 %, depending on the milling procedure and raw material quality [5].

Germs are a source of many valuable nutrients. They contain: lipids (6—15 %), protein (23—35 %), sugars (30—60 %), mineral salts (4.5—5.6 %), 21 elements (including manganese, cobalt, selenium, gold), nucleic acids (3.5—4.2 %), vitamins (group B, E, F and H), hormones (auxin a and b, secretin), other biologically active compounds and enzymes of redox, proteolytic and amylolytic nature [1, 4, 6, 9, 10, 14].

Owing to their particularly rich composition of biologically active substances, germs can find application in the pharmaceutical, food, cosmetic and chemical industry. For the cosmetic and pharmaceutical industry the lipid fraction is most important.

About 80 % of the lipid fraction consists of unsaturated fatty acids, mainly linoleic (44—57 %), oleic (17—30 %), linolenic (5—10 %), and traces of arachidonic acid [8]. Palmitic acid (about 18.5 %) is the main saturated fatty acid. Glycerides amount on the average to 8.17 % of the lipid fraction, phospholipids to 1.59 % and nonsaponifiable substances (sterols, vitamins, pigments etc.) to 0.49 %.

Apart from vitamin F, the most important vitamins of the lipid fraction comprise: tocopherols (25—30 mg per 100 g)(the biologically active form of vitamin E, i.e. α-tocopherol, amounting to more than one half of the tocopherols), provitamin A (660 i.u. per 100 g), provitamins $D_2$ (ergosterols) and vitamin K [4, 7].

The lipolytic enzymes present in the lipid fraction affect its components and thus lower the biological value of the germs. Storage studies of germs have shown that the maximal storage period amounts at 30 and 20 °C to 1 and 2 weeks, respectively [2]. Rancid fat lowers the organoleptic value of germs; moreover, carotene and most vitamins decompose (e.g., the vitamin E content drops by about 60 % after 10 days of germ storage). For prevention of these processes various stabilization methods are used, mainly involving inactivation of lipolytic enzymes (e.g., germ dehydratation or the fluidization method) [3].

The aim of the present studies was to develop a method for extraction of the biologically active lipid fraction from wheat and rye germs.

## Materials and methods

The material comprised fresh intact wheat and rye germs whose characterization is presented in Table 1.

Table 1
Quality indices of wheat and rye germs

| Physical and chemical indices | Results |
|---|---|
| Colour | Yellow to grey-yellow |
| Odour | Specific |
| Moisture content [%] | 9—12 |
| Acidity [%] | 8—16 |
| Lipid content in dry matter [%] | 9—11 |
| Content of organic contaminants (flour, bran) [%] | ca. 15 |
| Tocopherol content [mg/100 g] | 25—28 |
| Bulk density [kg/dm$^3$] | ca. 2.6 |

The criteria for wheat and rye germ evaluation included the following indices determined according to Polish norms:

1. Colour and odour [15];
2. moisture content [16];
3. acidity [17];
4. lipid content in dry matter [18];
5. content of organic contaminants (flour, bran) [19].

The criteria for assessment of lipid extracts comprised the following indices:

1. Colour and odour (assessed organoleptically);
2. index of refraction [20];
3. saponification number [21];
4. acid number [22];
5. unsaponifiable substances [23];
6. tocopherol content [12];
7. fatty acid content [24];
8. residual solvent content [25].

The extraction of the lipid fraction was carried out in the unit presented in Fig. 1. The apparatus made of acidproof steel consists of a vessel (2) holding a basket with a sieve bottom (3). A jacket-tubular cooler (1) is situated over the basket. A container for the final product (4), equipped with a heating jacket (5), is located under the basket. Cooling water is fed through steel tube (a) and flows out through tube (b). Heating water is fed through steel tube c and flows out through tube d. The solvent is introduced through steel tube (f) and leaves through tube (e). The apparatus is equipped with two peepholes, a manometer and a lock screw.

Liquid dichlorodifluoromethane was used for the extraction of the lipid fraction.

For the determination of the optimal extraction parameters a number of experiments were performed using different extraction times and temperature:

— extraction time: 1 × 15 min, 2 × 15 min, 30 min, 45 min, 60 min;
— extraction temperature: from 20 to 30 °C.

According to the results of these experiments, the optimal extraction parameters were: time 30 min and temperature 25 °C. The yields obtained under these conditions amounted to 95—98 % of those attained in a SOXHLET apparatus with petroleum ether as solvent.

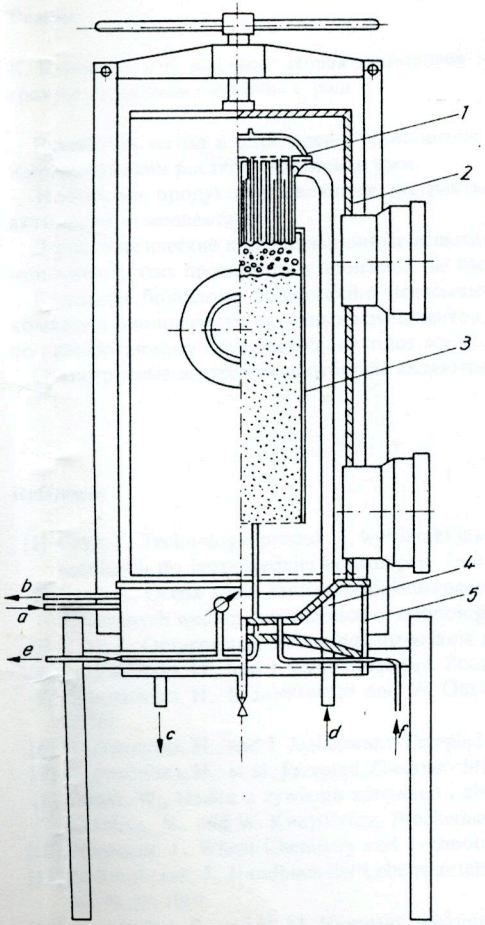


Fig. 1.
Extraction unit (explanations see in the text)

Table 2
Physical and chemical indices of extracts obtained from wheat and rye germs

| Physical and chemical indices | Extracts from wheat germs | | | Extracts from rye germs |
|---|---|---|---|---|
| | Own results | Literatura data | | Own results |
| | | [11] | [12] | |
| Colour | Pale yellow | — | — | Pale yellow |
| Odour | Specific cereal-like | — | — | Specific cereal-like |
| Density $n^{20}D$ | 1.4759 | 1.468—1.478 | — | 1.4762 |
| Saponification no. | 188.6 | 180—189 | 188 | 180.0 |
| Acid no. | 4.95 | — | 20.5 | 4.8 |
| Tocopherol content [%] | 0.40 | 0.20—0.30 | — | 0.32 |
| Unsaponifiable substances [%] | 4.90 | 3.5—6.0 | 0.45 | 5.5 |
| Residual solvent content | traces | — | — | traces |

## Results

The preparations obtained under optimal conditions of dichlorodifluoromethane extraction of wheat and rye germs are characterized in Tables 2 and 3.

Since the physical and chemical indices of the extracts obtained from wheat and rye are similar, rye germs may also be an appropriate raw material for the production of an oily extract rich in vitamin E and in other biologically active components.

The fatty acid composition of both kinds of extracts is shown in Table 3. In the preparations from wheat germs, the saturated fatty acids amount to 15.8—17.5%, and the unsaturated ones to 82.5—84.2% of total fatty acids, in case of the preparations from rye germs, the respective values are 18.2—18.7% and 80.9—81.8%.

The analysis of the extracts showed that the main physical and chemical indices, tocopherol content and ratio of unsaturated to saturated fatty acids are consistent with the data obtained from literature.

Application studies of the extracts performed in the cosmetic industry, gave positive results; an evaluation carried out at the Medical Academy in Warsaw confirmed their suitability for dermatological purposes. At present, their application in laryngology and geriatrics is investigated.

The technology reported has been carried into operation on an industrial scale.

Table 3
Fatty acid composition of extracts obtained from wheat and rye germs

| Extract | Fatty acids [%] | | | | | | |
|---|---|---|---|---|---|---|---|
| | Palmitic acid | Palmitooleic acid | Stearic acid | Oleic acid | Linoleic acid | Linolenic acid | Arachidonic acid |
| From wheat germs | 15.1 to 16.8 | 0 to 0.20 | 0.59 to 0.88 | 14.1 to 16.2 | 59.5 to 61.3 | 7.1 to 8.8 | — |
| From rye germs | 15.4 to 16.2 | 0.30 to 0.37 | 0.39 to 0.56 | 12.6 to 12.8 | 54.1 to 54.9 | 13.4 to 13.8 | 1.89 to 2.44 |

**Zusammenfassung**

K. Karwowska und E. Kostrzewa: Eine neue Technologie zur Herstellung hochwertiger Vitaminextrakte aus Weizen- und Roggenkeimen

Es wurde eine Methode zur fast vollständigen Extraktion der Lipidfraktionen aus Weizen- und Roggenkeimen einschließlich der Bestimmung technologischer Parameter des Produktionsprozesses erarbeitet. Die erhaltenen Präparate sind Extrakte, die reich an Vitamin E und anderen biologisch aktiven Komponenten sind. Dermatologische Untersuchungen und die Anwendung in der kosmetischen Industrie haben die Eignung der Präparate für kosmetische und pharmazeutische Erzeugnisse bestätigt. Wegen des hohen Gehaltes an ungesättigten Fettsäuren und der natürlichen Kombination biologisch aktiver Verbindungen finden die nach unserem Verfahren im industriellen Maßstab hergestellten Präparate aus Weizen- und Roggenkeimen zunehmende Verwendung. Die entfetteten Rückstände sind ein hochwertiges Futter.

**Резюме**

К. КАРВОВСКА и Е. КОСЧЕВА: Новая технология изготовления высококачественных витаминных экстрактов из ростков пшеницы и ржи

Разработан метод и определены технологические параметры процесса почти полной экстракции жирной фракции ростков пшеницы и ржи.

Исходными продуктами являются экстракты, богатые витамином Е и другими биологически активными компонентами.

Дерматологические и аппликационные испытания в косметической промышленности подтвердили пригодность этих препаратов в производстве косметических средств и фармацевтических продуктов.

Благодаря большому содержанию ненасыщенных жирных кислот и сохранению натурального комплекса биологически активных компонентов, экстракты из ростков пшеницы и ржи, получаемые по разработанному нами методу находят все большее применение в промышленном масштабе.

Обезжиренные экстрактные отбросы являются полноценным кормом.

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