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Conference Paper

Use of Physicochemical Method for Evaluation of Mucilage Producing Ability of the *Linum Usitatissimum* L. Seeds

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Abstract

In the modern medicine of many European countries flax is used as a medicament with a wide range of use. Wholesome effect of flax seeds is determined by the large amount of enveloping substances. This property is connected with content of mucilage up to 10% and glycoside linamarin. Flaxseed polysaccharides also possess anti-inflammatory effect. Furthermore, mucilage production can be a chemosystematic characteric of intraspecific taxons. In literature intervarietal variability data is limited. Therefore, comparative evaluation of mucilage producing ability of flax seeds with different morphotypes is of interest. The research of micromorphological characteristics of seed coat and mucilage production dynamics was carried out and it was established that mucilage-producing cells are localized predominantly in the external layer of seed coat. It was established that Bahmalskiy, Nebesnyj, Kustanayskiy yantar varieties possess the highest level of mucilage production. Morphotype and varietal specificity of mucilage production are determined, consequently it can be used as a marker feature of *L. usitatissimum* new forms. The proposed technique is based on the determination of seed physicochemical characteristics and can be used for express analysis of the vegetal samples and their differentiation by the directions of use: as a fatty oil or mucilage-containing raw material.

Keywords: *Linum usitatissimum* L. varieties, seeds, mucilage production, hydration dynamics, physicochemical method.

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1. Introduction

Flax is a valuable culture which is used in complex. In the modern medicine of many European countries flax is used as a medicament with a wide range of use [1, 2]. Wholesome effect of flax seeds is determined by the large amount of enveloping substances. This property is connected with content of mucilage up to 10% and glycoside linamarin. Flaxseed polysaccharides also possess anti-inflammatory effect. Furthermore, mucilage production can be a chemosystematic characteric of intraspecific taxons. In literature intervarietal variability data is limited [3-5].

Aim of research – comparative evaluation of mucilage producing ability of flax varieties with different morphotypes.

2. Materials and methods

Seeds of the following varieties of flax served as a material for research: long-fibred flax – Belinka, Aleksim, Belochka; intermediate flax – VNIIMK 620, Kentavr, Isilkulskiy, VNIIMK 630, Nebesnyj, Kustanayskiy yantar, VNIIMK 622, Istok, Sokol, Sanlin, Kinelskiy 2000; crown flax – Artikskiy 7, Karabalyikskiy 7, Bahmalskiy. 1 ml medical syringes were used for evaluation of hydration dynamics. Seeds (volume of 0.30 ml) were put in syringes and then the syringes were filled with water to 1 ml. After that, mucilage production degree was determined after 1, 2, 3, 4, 24, 48, 72 hours by the increase in volume of seed samples of different varieties. Quantitative determination of hydrated polysaccharides was carried out via gravimetric method: seeds were weighed before and after putting into water (according to the State Pharmacopoeia of Russian Federation, XIII edition) [3].

3. Results and discussion

Ripe flax seed is egg-shaped with slightly narrowed and curved end. Seeds are up to 6 mm long and 3 mm wide, they have unequal sides. Their surface is smooth, shiny. The color of the studied seeds varies from light yellow to dark brown. Seeds consist of three main parts: seed coat, endosperm and embryo. Anatomical study of seed coat structure showed the presence of several layers: epidermal cells, layers of parenchymal cells, cells of ground tissue, cells of "transverse layer" and pigment layer. External layer of the seed coat is represented by the large quadrangular cells, which are able to swell and produce mucilage when wetting with water (Figure 1). Vegetal mucilage is a mixture of three high molecular weight polysaccharides, neutral and two acidic, which differ in their physicochemical properties [6, 7]. During the experiment, nonlinear dynamics of mucilage production is revealed. Seeds swell mainly within the first hour after putting into distilled water, then the deceleration occurs. In this connection, we consider that mucilage-producing cells are localized mostly in the external layer. It was also confirmed by the microscopy data. Within 24 hours 2-3 periods of acceleration and deceleration of mucilage production are revealed (depending on the variety). Further increase in volume of seeds (i.e. colloid substances in solution) was not registered (Figure 2).

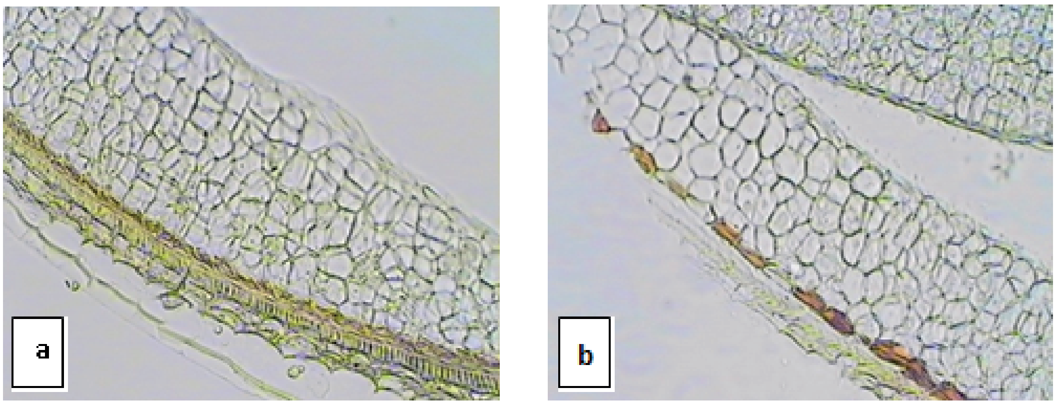

Figure 1: Micromorphology of the flax whole raw material: a – Istok 2014 (10 × 15), b – Severnyiy (10×15).

Presumably, revealed dynamics of increase in volume of hydrated flax seeds can be connected with nonsimultaneous swelling. Besides, various fractions of mucilage-producing polysaccharides pass into solution [6]. Based on the results of the experiment, varieties can be divided into three groups: with low level of mucilage production (Sanlin, Belinka, Kustanayskiy yantar, VNIIMK 622, VNIIMK 630, VNIIMK 620, Kentavr), with average level (Karabalyikskiy 7, Sokol, Belochka, Aleksim, Nebesnyj, Artikskiy 7, Istok 2004, Severnyiy, Istok 2014) and with high level (Isilkulskiy, Bahmalskiy, Kinelskiy 2000) (Figure 3).

Seeds of the following varieties of the crown flax and intermediate flax possess the highest intensity of mucilage production: VNIIMK 620, Nebesnyj, Bahmalskiy, Kustanayskiy yantar (tables 1, 2; Figure 4). Seeds of the long-fibred flax varieties (Aleksim, Belinka и Belochka) and Sanlin variety showed the lowest results. Coefficients of variation vary from 0.0% to 14.7%. It indicates a relative homogeneity, slight variability and high reliability of the received experimental data.

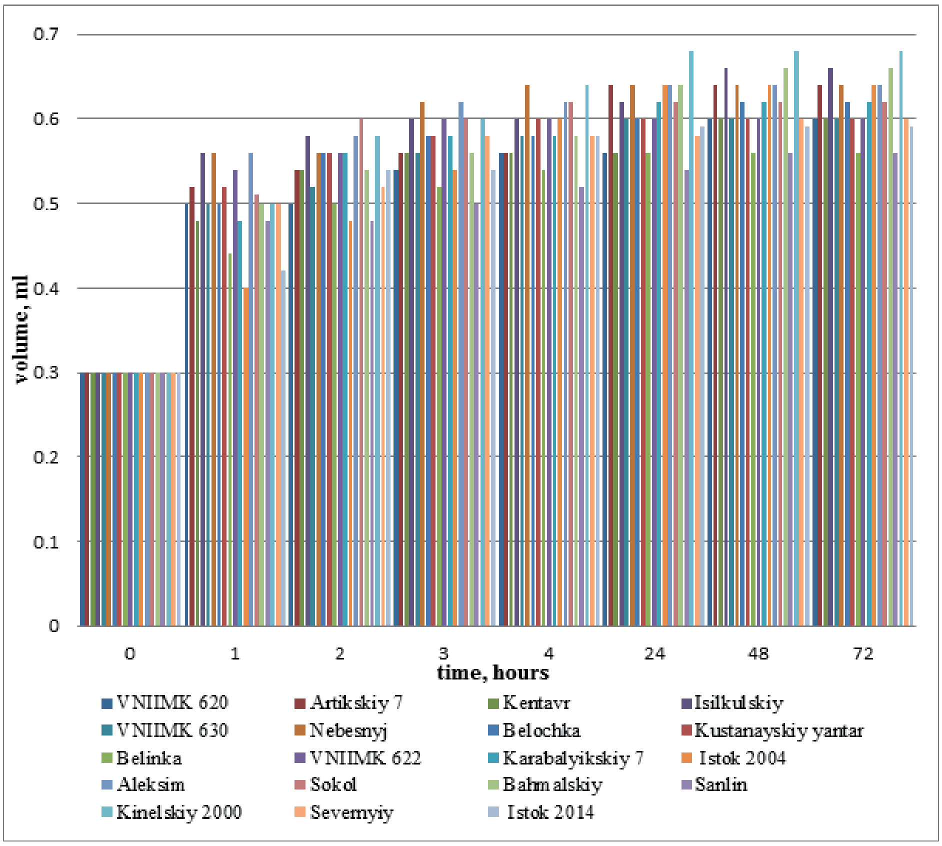

Figure 2: Mucilage production dynamics of the seeds of modern flax varieties.

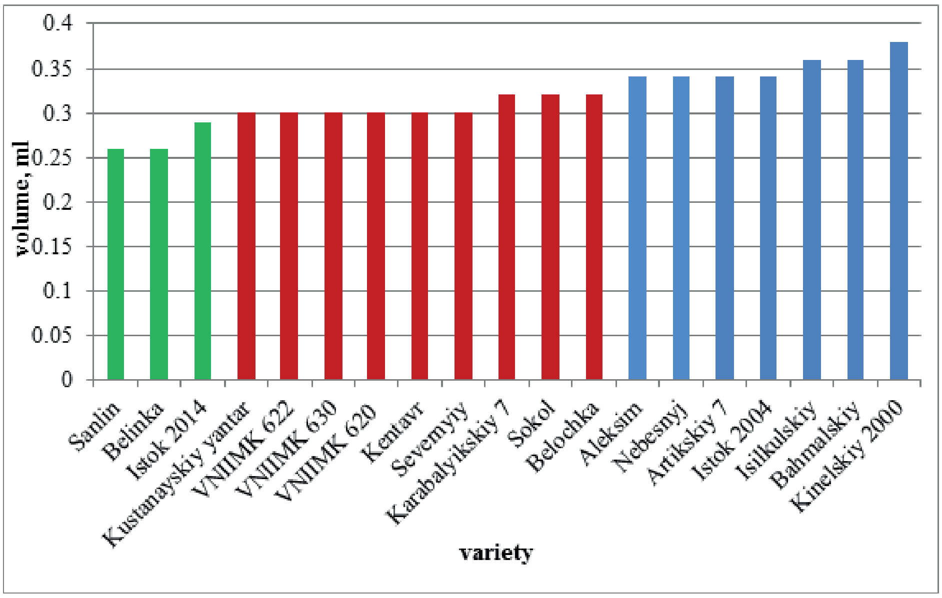

Figure 3: Ranking of modern flax varieties by the mucilage production degree (increase in volume during hydration).

Table 1: Mucilage producing ability of flax seeds.

№	Variety	Mucilage producing ability					
		Per g of dry seeds, Δ ml[a]	Relative error, %	Coefficient of variation, %	Per 1000 seeds	Relative error, %	Coefficient of variation, %
1	Sanlin	0.74±0.02	2.6	2.2	6.8±0.3	3.7	4.4
2	Belinka	0.67±0.03	4.4	4.1	6.9±0.4	5.7	5.8
3	Istok 2014	0.63±0.01	1.6	1.2	8.8±0.0	0.0	0.0
4	Kustanayskiy yantar	0.61±0.02	2.9	1.4	9.7±0.4	3.6	4.1
5	VNIIMK 622	0.59±0.02	3.4	2.8	10.0±0.3	3.0	3.0
6	VNIIMK 630	0.65±0.07	10.7	10.6	9.4±0.2	1.6	2.1
7	VNIIMK 620	0.65±0.01	0.7	0.0	12.4±.0.4	3.3	3.2
8	Kentavr	0.65±0.02	3.0	3.1	8.7±0.2	2.3	2.3
9	Severnyiy	0.68±0.01	1.4	1.3	12.0±0.0	0.0	0.0
10	Karabalyikskiy 7	0.56±0.03	5.3	5.4	12.5±0.2	1.6	1.6
11	Sokol	0.53±0.01	1.8	1.9	11.0±0.3	2.7	5.8
12	Belochka	0.59±0.02	3.3	2.8	7.5±0.1	1.3	1.3
13	Aleksim	0.58±0.01	1.7	2.4	6.6±0.1	1.5	1.5
14	Nebesnyj	0.56±0.03	5.3	5.2	10.6±0.3	2.8	2.8
15	Artikskiy 7	0.57±0.02	2.6	1.8	9.7±0.3	3.1	3.1
16	Istok 2004	0.59±0.01	1.7	1.6	8.5±0.0	0.0	0.0
17	Isilkulskiy	0.49±0.07	14.3	14.7	10.8±0.5	4.6	4.6
18	Bahmalskiy	0.52±0.01	1.9	1.3	10.9±0.4	3.1	3.7
19	Kinelskiy 2000	0.53±0.02	3.7	3.2	9.4±0.1	1.1	1.6
20	Lim (min...max)	0.49...0.74	0.7... 14.3	0.0... 14.7	6.5... 12.4	0.0... 5.7	0.0... 5.8

[a]Δ ml – volume increase.

Table 2: Mucilage production intensity of flax seeds.

№	Variety	Mucilage production intensity					
		Per g of dry seeds, Δ g[a]	Relative error, %	Coefficient of variation, %	Per 1000 seeds	Relative error, %	Coefficient of variation, %
1	Sanlin	1.25±0.07	5.6	8.5	5.9±0.4	6.8	6.8
2	Belinka	1.41±0.02	1.4	0.8	6.4±0.1	0.8	0.8
3	Istok 2014	1.41±0.01	0.7	0.7	8.1±0.2	2.4	2.5
4	Kustanayskiy yantar	1.68±0.01	0.6	0.6	10.0±0.2	2.0	2.0
5	VNIIMK 622	1.23±0.01	0.8	1.0	7.5±0.1	0.7	0.7
6	VNIIMK 630	1.08±0.01	0.9	0.9	6.6±0.1	1.5	1.5
7	VNIIMK 620	1.66±0.02	1.2	1.2	12.3±0.7	5.6	5.7
8	Kentavr	1.39±0.02	1.4	0.7	7.4±0.4	5.4	5.4
9	Severnyiy	1.58±0.01	0.6	0.6	13.6±0.2	1.5	1.5
10	Karabalyikskiy7	1.33±0.22	16.5	12.7	8.2±0.8	9.7	9.8
11	Sokol	1.56±0.03	1.9	1.9	8.5±0.2	2.4	2.4
12	Belochka	1.59±0.09	5.7	5.8	6.6±0.1	1.5	1.5
13	Aleksim	1.86±0.21	11.2	6.3	6.2±0.7	11.2	11.3
14	Nebesnyj	1.93±0.17	8.8	5.5	10.8±0.7	6.4	6.5
15	Artikskiy 7	1.47±0.03	2.0	2.1	8.4±0.2	2.4	2.4
16	Istok 2004	1.47±0.04	2.7	1.7	7.2±0.1	1.4	1.4
17	Isilkulskiy	1.36±0.05	3.7	4.2	7.5±0.2	2.7	2.7
18	Bahmalskiy	1.77±0.01	0.6	0.5	10.0±0.1	1.0	1.0
19	Kinelskiy 2000	1.98±0.01	0.5	0.4	8.7±.0.9	10.3	10.3
20	Lim (min...max)	1.08...1.93	0.6... 16.5	0.4... 12.7	5.9... 13.6	0.7... 11.2	0.7... 11.3

[a]Δ g – increase in mass of hydrated seeds compared with dry seeds.

4. Conclusion

Micromorphological features of the flax seed coat are studied. Comparative evaluation of seeds of modern varieties is given using the proposed technique of analysis of

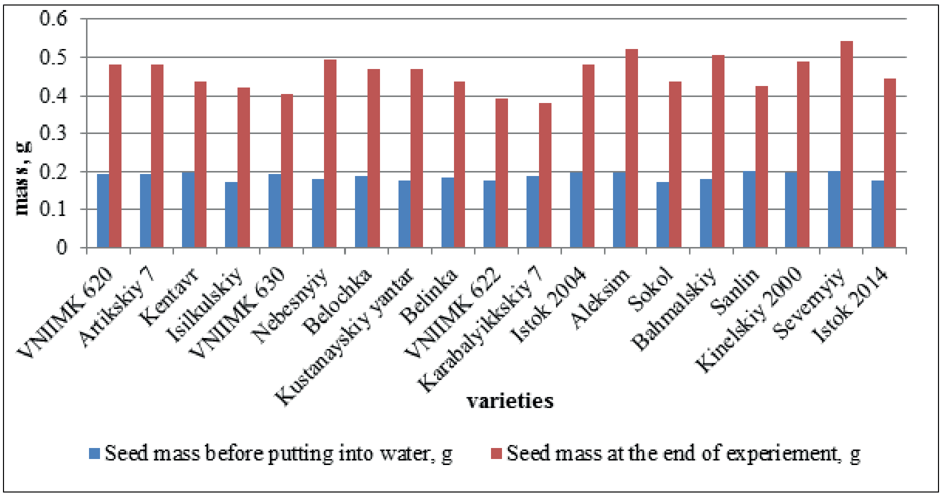

Figure 4: Change in the weight of flax seeds during hydration.

mucilage production ability. Bahmalskiy, Nebesnyj, Kustanayskiy yantar varieties possess the highest degree of mucilage production. The proposed technique is based on the determination of seed physicochemical characteristics and can be used for express analysis of the vegetal samples and their differentiation by the directions of use: as a fatty oil or mucilage-containing raw material.

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