SEPARATION OF CHOPPED NETTLE MATERIAL ON PLANE SIEVE LENGTH

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ABSTRACT

The paper presents the results of several experimental researches regarding to a separation mixture of dried and chopped nettle fragments on a dimensional separator of medicinal plants, equipped with oscillating flat sieves. Three parameters were varied (material flow rate, sieves angle of inclination and oscillations sieves frequency). For separation process description along chopped vegetal material sieves, the experimental results have been tested by Rosin-Rammler distribution law.

INTRODUCTION

Medicinal plants contain active biologic substances with therapeutic value. Cultivation and capitalization of these plants by different processing operations are important for ensuring an increased amount of raw material and for valuable constituents preserving or growing these plants.

It is possible to achieve quality phytoterapeutic products and accessible, only by using advanced technical equipment, adapted to every plant [5].

Medicinal plant primary and advanced processing suppose volatile oils obtaining, macerated tea, vegetable extracts, tinctures, syrups, tablets, food colourings, cosmetics, natural fertilizers, bio-insecticides etc [6].

In terms of structure, processing technological process includes all operations and interrelated phases, necessary for prepare and carrying on the acquired harvested vegetable material in an appropriate state storage, packaging or processing within a production unit [5, 8].

Technological operations of obtaining concentrated alcoholic and hydro-alcoholic and extracts are as follows: Harvesting, – Conditioning – Chopping/– Separation – Extraction.Chopping and vegetable product separation (leaves, flowers, roots and rhizomes) are important in performing extractive solutions.

By increasing contact surface between vegetable product and solvent it's reducing extraction time and in the same time increase extraction yield.

Grinding degree and vegetable products separation is established in function of morphology and plant humidity, by utilized extraction process, by used extraction solvent.

In generally, for extraction by maceration, infusion or decoction, a chopping, respectively a separation into larger fragments are done and for extraction by percolation the plant is chopped, respectively separate under the form of fine dust.

To perform the sorting operation of medicinal plants is used complex equipment, specific to this area, which comprises oscillating flat sieves [3, 8].

The sieves oscillating movement is characterise by its main parameters (oscillationfrequency and oscillation amplitude), of parameters linked by process and by material characteristics to be processed [4, 5, 9].

From nettle (*Urtica dioica, Fam. Urticaceae) to used vegetable product is represented by* the aerial part and root, rich in active principles, such as: flavonoids, mucilages, volatile oils, organic acids (acetic, panthotenic, folic), vitamin (C, K, B2), betacarotene, mineral salts, chlorophylls, a vesical substance for skin, composed of formic acid, enzymes, fatty acids, phytosterols, coumarin, amino acids, a Urtica-dioica-agglutinin complex, lignans and prosaccharides.

Due to the richness in chlorophyll, the nettle is a very valuable raw material in cosmetics and dermatology. It is uses the whole plant, which is antiseptic, antimicrobial, decongestive, disinfectant, epithelising, revulsive [1].

This paper presents vegetal process separation of nettle on oscillating flat sieve lengths, varying different parameters.

MATERIAL AND METHOD

At experimental determinations were used nettle plants, identifiedand harvestedwithin spontaneous flora, in respect to their morphological characteristics and according to specialty guides [1].

White nettle *(Urtica dioica)*is a species of herbaceous, perennial, high from 20 to 50 (70) cm, with aerial stems, erect or ascending, Lamium genus, Lamiaceae family, widespread from hilly zone to alpine one.

Harvesting takes place within blossom, from April until September [1].

White nettle was natural dried, in the shade, until storage humidity (maximum 13 %), cleaned of foreign bodies (inorganic materials or other plants, injured parties) according to stipulations within [10,11], then was chopped in bulk at medicinal plants chopper machine, TIMATIC type, set at 6 mm size.

The experimental researches were conducted on a dimensional sortator of cut plants (Figure 1), existing in working within INMA Bucharest, equipped with 9 sieve frames with bore sizes ranging from 1.15 to 13.2 mm, used in sets of three as needed.

The bedframe construction allows access to sieves for cleaning in case of warping. The sieves bedframe rests on a support made of welded rolled profiles by means of rubber shock absorbers.Vibrating motors are mounted on symmetrically welded plates outside of which construction enables their rotation and changing inclined position to the horizontal in order to adjust the amplitude and frequency of oscillation.

Sieve tilting the can vary between 12-15^{0}depending on the type of the culture, but also by other unwanted plants parties.

The supply of the sorter material was carried out by means of an inclined conveyor belt, which carry on plant material in the centre of the sorter feed hopper and from there on its upper sieve where the separation process takes place.

The experiments were performed on a sieve with squares measuring 6.3 mm, sieve having a length of 1.395 m and a width of 0.6 m. Under chosen sieve, a sheet collection box was fitted (Fig. 2) delineated into seven equal compartments, each compartment having 0,195 m.

Fig. 1 - Sorter of cut plants

Fig. 2 - Collection box

During experiments were used three sieve inclination angles of inclination ($12,08^0$, $13,33^0$, $14,7^0$), for each angle ware varied two feed debits (60 kg/h, 45 kg/h) and two vibration frequency (50 Hz, 40 Hz).

Interpretation of results was done by separating cumulative correlation experimental data on sieve along with theoretical data obtained using the Rosin-Rammler equation [2.7], represented by the relation (1):

$$R = e^{-\left(\frac{D}{D_n}\right)^n} \quad (1)$$

where:

R is the cumulative retained at a size D (%);

D is the particle size (mm);

D_n and n are fitting parameters.

RESULTS

Primary experimental data on separate plant fragments along sieve separate for different feed rates, oscillation frequencies and angles of inclination of the grid were reported in Table 1.

Table 1

Experimental data on separation intensity along sieve

Frequency [Hz]	Flow rate adjusted, [kg/h]	*Sieve length from which chicory fragments are collected, m*						
		0.195	*0.395*	*0.595*	*0.795*	*0.995*	*1.195*	*1.395*
		Separated fragments percentage (*intensity separation*), [%]						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Slope angle, $12,08^0$								
50	60	21.87	22.81	31.54	14.38	3.74	3.12	2.54
	45	39.07	27.04	16.16	9.66	3.55	2.55	1.96
40	60	43.28	40.57	9.13	3.01	1.22	1.45	1.35
	45	46.70	32.39	9.73	4.68	2.77	1.97	1.77
Slope angle, $13,33^0$								
50	60	18.47	17.79	22.46	32.18	3.90	2.46	2.73
	45	21.73	19.77	23.01	24.58	4.87	3.35	2.68
40	60	32.19	31.39	19.71	9.89	3.00	2.10	1.71
	45	36.77	33.88	13.81	8.88	2.75	2.27	1.64
Slope angle, $14,7^0$								
50	60	17.71	18.87	27.89	25.05	4.87	3.32	2.28
	45	19.82	20.37	27.40	22.29	4.51	3.19	2.42
40	60	23.77	33.42	22.65	11.04	4.00	3.34	1.77
	45	27.78	30.37	21.97	13.38	3.01	2.25	1.24

Results obtained after nettle fragments separation were graphic represented in figure 3, by representing variation curves of separation intensity.

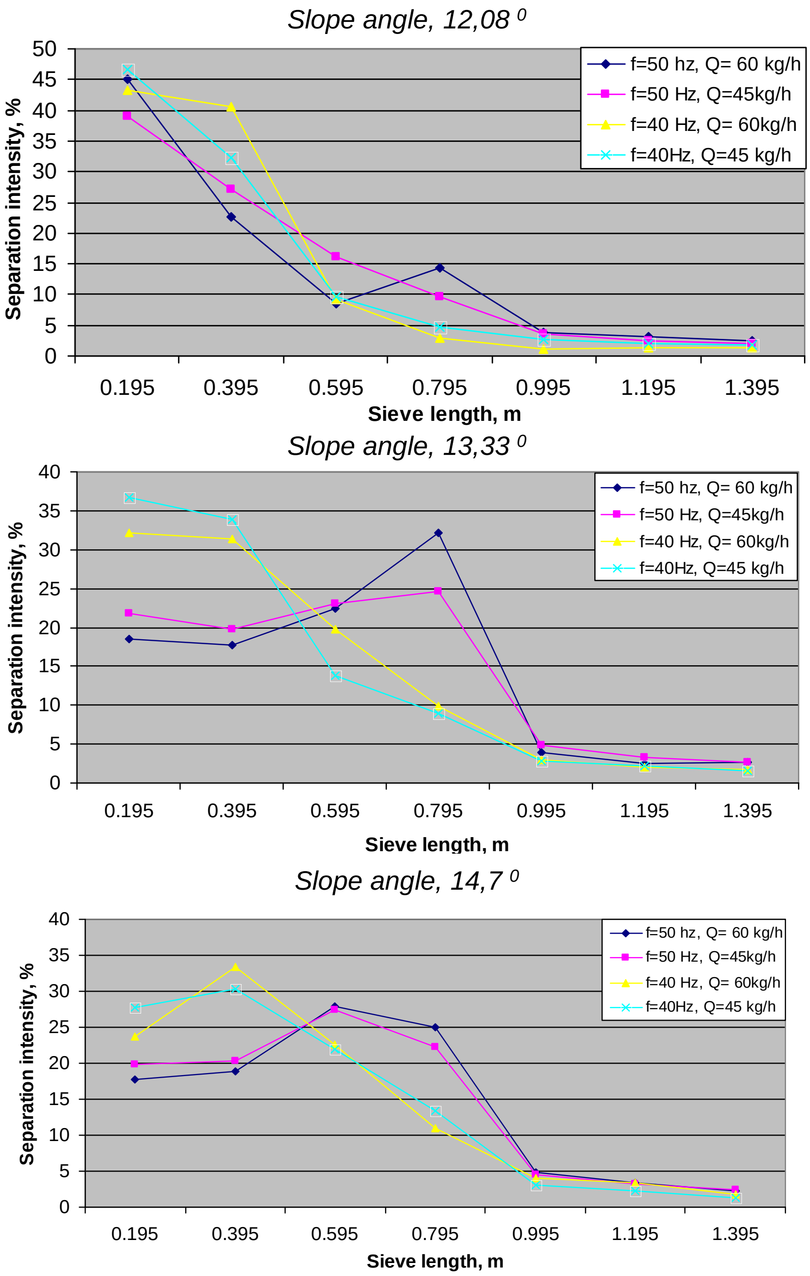

Fig. 3 -Intensity variation of nettle fragments separation, on sieve length

Nettle fragments separation efficiency along sieve is shown by the degree of separation and separation cumulative. The separation intensity on sieve length of is defined by the percent (%) of fragments separated in each box compartment from the total amount of fragments that are in the collection box.

Cumulative separation is defined as percentage of separated fragments (%) gathered in compartments (united) from total amount of fragments in the collection box.

Referring to figure 3 is observed that separation intensity decreases on the sieve length and came to be insignificant at the end of the grid. The intensity of separation is maximum for low frequencies in feeding zone and for high frequency at half sieve, regardless of its angle of inclination.

Results obtained after cumulative separation process of nettle fragments, were mathematic al modelling using Rosin Rammler function. Both experimental results and theoretical ones were graphically represented in figure 4.

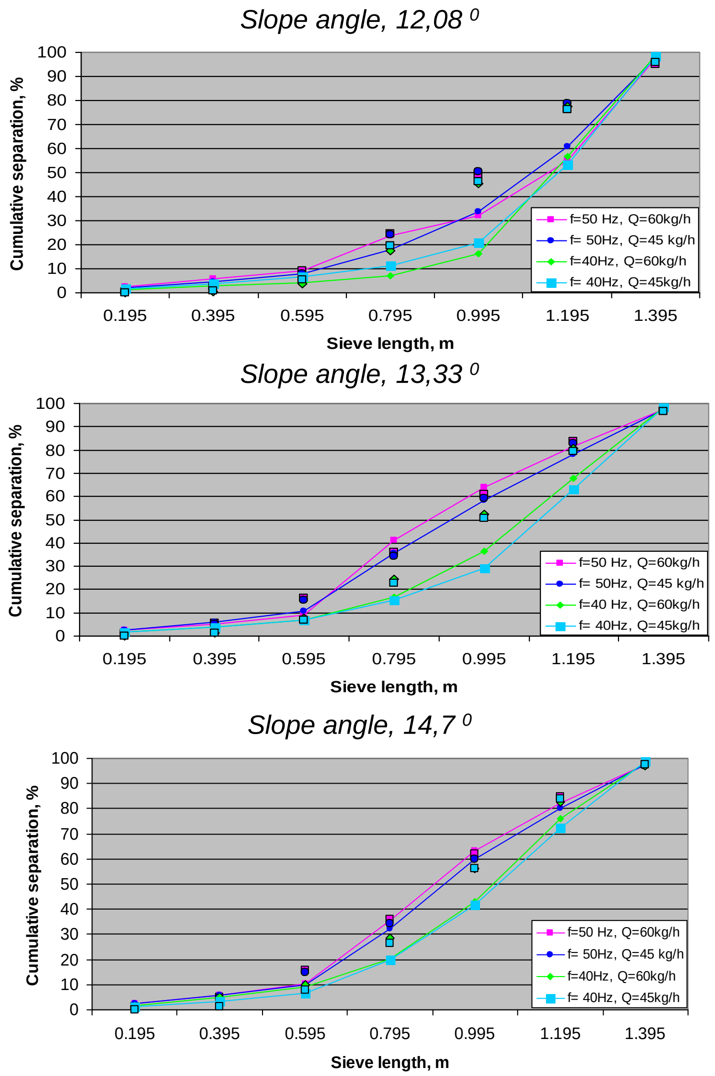

Fig. 4 - Cumulative variation of nettle fragments separation, on length of flat sieves, for three slope angle, for experimental values (represented by cu lines) and for Rosin-Rammler mathematical model values (represented without lines)

Coefficients values $D_n$and n for experimental data correlated with Rosin-Rammler equation (ec. 1), and R^2 correlation coefficient are presented in table 2.

Table 2

Coefficient values for experimental data correlated with Rosin-Rammler law type (ec. 1), D_n and n, and the R^2 coefficient of correlation for nettle

Experimental parameters	Coefficients								
	D_n	n	R^2	D_n	n	R^2	D_n	n	R^2
	Slope angle 12,08⁰			***Slope angle 13,33⁰***			***Slope angle 14,7⁰***		
	Frequency 50 Hz								
Q_{alim} =60 kg/h	1.452	2.347	0.912	1.270	2.523	0.991	1.271	2.617	0.994
Q_{alim} =45 kg/h	1.446	2.546	0.925	1.294	2.479	0.991	1.294	2.566	0.992
	Frequency 40 Hz								
Q_{alim} =60 kg/h	1.541	2.772	0.878	1.428	2.683	0.942	1.367	2.698	0.966
Q_{alim} =45 kg/h	1.521	2.575	0.883	1.456	2.667	0.921	1.388	2.882	0.952

CONCLUSIONS

Analyzing both experimental data and theoretical it is appreciated that to all three sieve slope angles are necessary large frequency values of 50 Hz to avoid material stratification and to perform a complete separation.

In case of higher flow rates to achieve high efficiency, high frequencies are required. As, for separation to be made in good conditions at small angles of inclination of the sieve feed rate and it has to be small, because refused fragments, tend to block the screen openings.

However, at high frequencies, large fragments quickly get in contact with the screen even if stratification is increasing and is more able to separate through the mesh holes if time crossing through holes is enough.

In the paper was presented the mode in which it is used distribution length low (Rosin-Rammler equation) of vegetable fragments in nettle fragments repartition on oscillating in function of plane sieve length in function of sieves hole dimensions. It is noted that the chosen equation it is correlated well enough with experimental data values, being obtained high correlation coefficients $R^2 \geq 0,878$.

On worldwide and our country are concerns regarding to cultivation and processing medicinal and aromatic plants.

Therefore, by development of research work process of processed herbs equipment to improve their constructive and functional performance, supports growers and processors in the field, to get food, pharmaceutical, plant protection, quality cosmetics.

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