INVESTIGATION OF OIL EXTRACTION FROM WHOLE SEED OF YUGOSLAV SUNFLOWER HYBRIDS

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ABSTRACT

The oil extraction rate was investigated applying the laboratory tube extractor. The six samples of Yugoslav sunflowerseed hybrids were marked as follows: NS-H-15, NS-H-26RM, NS-H-27RM, NS-H-33, NS-H-43 and NS-H-44. The ground whole seed was heat treated at 110°C for 30 min before extraction. Commercial hexene at 55°C was used for extraction. The time needed to lower the oil content in the material til 1% was the bases for the comparation of oil extraction rate. The obtained results showed that there are certain differences in the behaviour of hybrids during extraction. For that reason, some technological characteristics of the hybrids, that can be the cause for the mentioned differences, were determined too. These are: hul/kernel ratio, hull thickness, wax content of the seed, as well as the porosity, coefficient of filtration and the resistance coefficient of the layer of material being extracted.

INTRODUCTION

The aim of hybridization is to obtain hybrids resistant to diseases, with high yields and oil content (Škoric et al. 1986). However, it is evident that the oil content increase of the new hybrids was followed by the change of technical-technological characteristics and this fact influences significantly the behaviour of material during extraction (Karlović et al. 1986). When investigating the characteristics of the seed, the Soviet authors have established that the differences of the characteristics of modern sunflowerseed sorts and hybrids are significant (Božko et al. 1980, Ksandopulo et al. 1986). That induced us to investigate the extraction kinetics and the regime of solvent flow during extraction of different hybrids.

MATERIAL AND TECHNICS

To recognize more completely the behaviour of hybrids during extraction, 6 Yugoslav sunflowerseed hybrids were investigated. The whole seed was ground and heat treated at 110°C for 30 minutes before extraction. The extraction rate was determined in the laboratory tube extractor according to VNIIŽ methodology (Ržehin et al. 1965). To describe the flow of extraction til the oil content in the material decreases below 5%, the empiric equation $C = a \cdot e^{b\tau}$ (c - oil content % DB, a - coefficient, b - coefficient, τ - time of extraction, min) (Karlović et al. 1986) was used. The following characteristics

of the material were determined before extraction: granulation and porosity of layer of material, the ability of solvent absorption, filtration coefficient and layer resistance coefficient (Rzehin et al. 1965). Oil content, hull/kernel ratio, hull thickness and the specific mass of the seed (Rzehin et al. 1965) and the waxes content of the seed (Matijasevic et al. 1973) were the characteristics determined in the hybrids.

RESULTS AND DISCUSSION

The kind, designation as well as some technological characteristics of the samples are given in Table 1. The results of seed technical-technological characteristics investigation show that the hull to kernel ratio is in a rather broad range, from 0,38 to 0,51. One can conclude that the hull of NS-H-27RM hybrid is the thinnest while it is the thickest of NS-H-44 hybrid. The waxes content in the seed of these hybrids ranges from 0,31 to 0,66%, and this is about 2 times lower than the value we stated earlier in new hybrids (Turkulov et al. 1983).

Table 1. Kind, designation and some technological characteristcs of sunflowerseed

Design. number	Hybrid	Oil content % DB	Hull to kernel ratio g/g	Distribution of hull thickness mm ratio in %			Specific mass of seed g/cm^3	Waxes content in the seed %
				0,1	0,2	0,3		
1	NS-H-15	40,10	0,43	19	45	36	0,74	0,31
2	NS-H-26RM	38,84	0,51	18	55	27	0,71	0,40
3	NS-H-27RM	42,90	0,42	56	39	5	0,72	0,46
4	NS-H-33	40,28	0,44	13	54	33	0,69	0,66
5	NS-H-43	43,72	0,41	14	53	33	0,70	0,53
6	NS-H-44	47,96	0,38	19	43	38	0,77	0,40

To get an impression on the behaviour of the mentioned hybrids during extraction, we followed the drop of solvent pressure depending on the flow in the tube extractor, the diameter of which was 50 mm, and the height of the layer of material was 300 mm. The results are given in Fig. 1. It can be seen that all the hybrids prepared on the mentioned way, offer considerably higher resistance to the flow of solvent compared to the sunflowerseed cake and soybean flakes.

It should be noted that the biggest drop of pressure was found for sample 3, that is hybrid HS-H-27 RM, which has considerably thinner hull than the other hybrids. On the bases of these measurements the filtration coefficient and the layer resisistance coefficient were calculated for these hybrids using the Darcy - Weisbach equation

$$p = \lambda \frac{1}{d} \cdot \frac{w^2 \cdot \rho}{2}$$

(p - drop of fluid pressure during the flow through the layer, λ - coefficient of logitudinal friction,

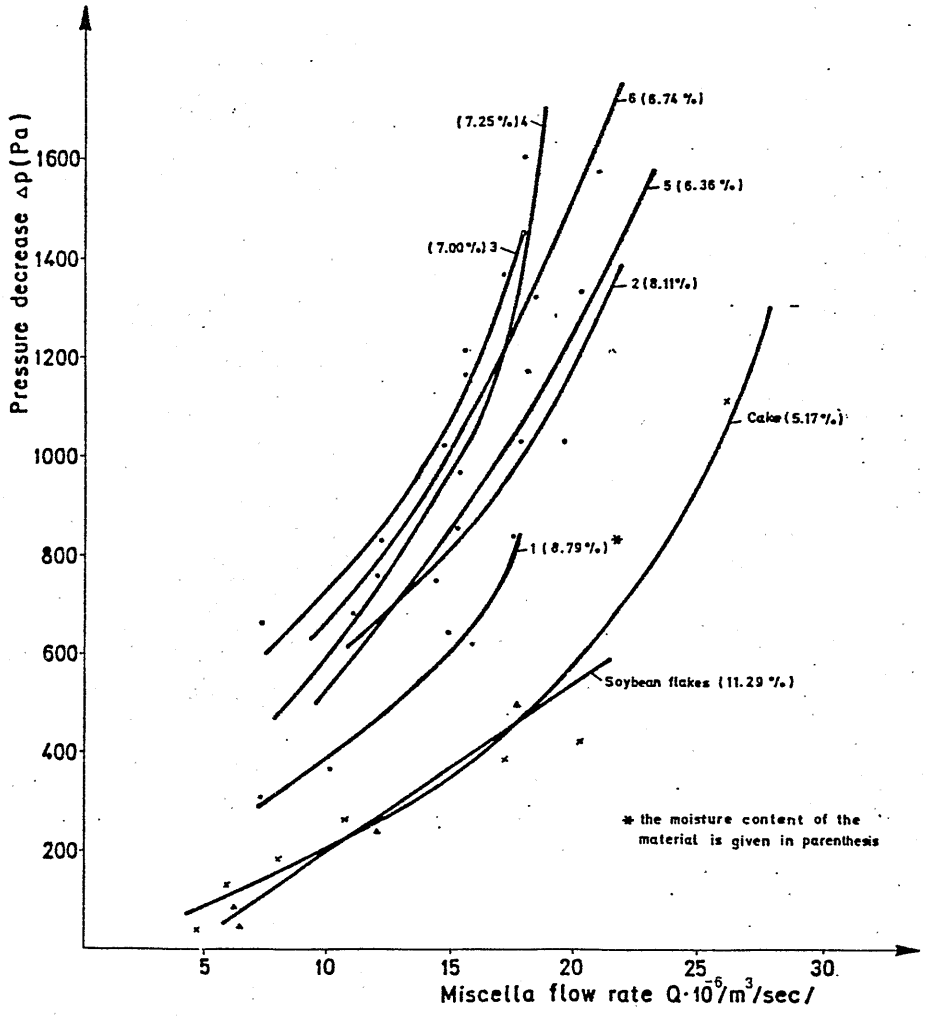

Figure 1. Drop of solvent pressure through the layer of material for the extraction depending on the flow rate

d - tube diameter, m, W - flow rate, m/s, ρ - solvent density, kg/m³) (Perry 1969).

Table 2. Filtration characteristics of the samples

Designation	Moisture content %	Layer porosity %	Quantity of absorbed solvent %	Filtration coefficient $K \cdot 10^{-6}$ $m^2/Pa\,s$	Layer resistance coefficient $c \cdot 10^{-13}$ m^3/Pa
1	8,79	62	9	3,53	2,67
2	8,11	63	12	2,70	2,10
3	7,00	65	16	2,17	1,78
4	7,25	63	14	2,08	1,50
5	6,36	63	12	2,11	1,56
6	6,74	61	9	2,14	1,72

The values given in Table 2 show that there are considerable differences in the quantity of absorbed solvent, though the porosity is very similar. The biggest quantity of absorbed solvent was found in sample 3. Taking in consideration that all the samples were prepared in the same way for the extraction and the granulation was very similar, this fact can be linked with the structural characteristics of the seed of this hybrid having the thinnest hull.

The results of the investigation of extraction kinetics of hybrids NS-H-27RM, NS-H-33 and 44 are given in Figure 2. The flow of extraction of Peredovik sunflowerseed as well as of cake obtained in industrial conditions is shown too.

CONCLUSION

On the bases of calculated values of coefficients $\underline{a}$ and $\underline{b}$ in the equation $C = a \cdot e^{\underline{b}t}$, which describes this period of extraction, it can be concluded that the oil extraction from all hybrids is somewhat faster than from the mentioned sort that is, at the same conditions, 14 - 16% less time is needed for the extraction of the hybrids compared to this sort. However, the extraction rate of the hybrids compared to the one of the cake is slower and this points to the fact that heat treatment is not enough to obtain material which can be processed by direct extraction.

Sample	Moisture %	a	b	Correlation coefficient
Peredovik sort	7,32	3,8874	-0,0279	0,9718
NS-H-27 RM	7,00	5.1658	-0,0156	0,9883
NS-H-33	7,25	4,8035	-0,0202	0,9844
NS-H-44	6,74	4,7575	-0,0163	0,9854
Cake	5,17	4,8045	-0,0372	0,9522

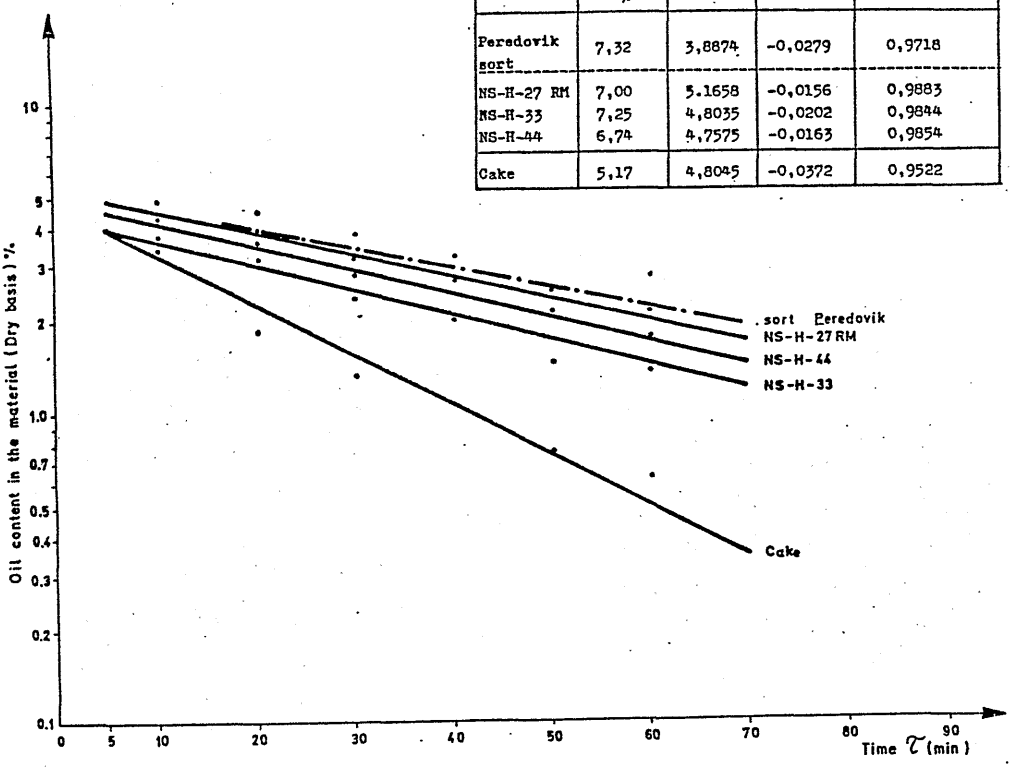

Figure 2. Change of oil content during oil extraction from whole sunflowerseed, hybrids NS-H-27RM, NS-H-33 and HS-H-44, as well as of Peredovik sort, and cake

LITERATURE

1. Božko M.F., O.A. Beljaeva, V.G. Viljkivskaja, N.P. Granica, A.A. Grebennik, V.J. Plehno, 1986, Svojstva semena savremenih sorti i hibrida suncokreta, Maslo-žirovaja promišlenost 62:(3) 3-6
2. Karlović Dj., J. Turkulov, E. Dimić, M. Sovilj, V. Vukša, 1986, Determination of some technological parameters and kinetics of sunflowerseed oil extraction, Uljarstvo, 23: (3-4) 67-72
3. Ksandopulo L.N., S.F. Bikova, V.V. Ključkin, 1986, Karakteristike prerade hibridnih semena suncokreta, Masložirovaja promišlenost 62: (7) 7-9

4. Matijaševi ć B.O., J. Turkulov, 1973, Revue Francaise des Corps Gras, 20: (1) 5-8
5. Perry J.H., 1969, Chemical Engineers Handbook, Mc Graw - Hill Book Company, New York
6. Ržehin V.P., A.G. Sergeev, 1965, Rukovodostvo po metodam isledovanija, tehnohimičeskomu kontrolju i učetu proizvodstva u maslo-žirovoj promišlenosti, Tom II, VNIIŽ, Lenjingrad
7. Škori ć D., R. Marinkovi ć, 1986, Najnoviji rezultati u selekciji suncokreta, Savetovanje o unapredjenju uljarstva Jugoslavije, Herceg Novi