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CONCERNING THE STORING STABILITY OF SUNFLOWER SEEDS AND THE OIL OBTAINED FROM THEM

The economic performance of enterprises processing sunflower seeds largely depends on the seeds' quality which continuously changes during storing. Enterprises or procurement organisations keep finished oil for some time, whose quality also changes. We believe it would be of great interest to obtain comparative qualitative indicators of seeds and oil obtained from the same batch of seeds in production conditions and stored for a long time (up to one year). Insofar as production seeds differ in their quality to a considerable extent we studied their various components and also separate sunflower seed tissues, determining the percentage of different oxidation products in them and the oxidation resistance of their lipids.

The work was also aimed at obtaining and investigating the multifactorial mathematical model of storing sunflower seeds that would make it possible to evaluate the influence of the principal storage parameters on the increment in the oil's acid number in time.

The seeds were kept in the mechanised storehouse of the oil-producing enterprise in the town of Knezh (Bulgaria). The seeds' moisture was 6.5% and impurity 2%. Samples were selected each month, and seeds were subjected to experimental processing during a shift. Raw pressed and refined oil obtained in the initial period of the seeds' processing was kept in the bottles in the laboratory.

The seed and oil quality was evaluated by the acid, peroxide and aniside number and by the extinction of the 0.2% solution at 232 nm. Data on the oil and seed stability were obtained directly from storage itself during nine months and through the accelerated refractometric method. The aniside number (An. n.), which is a modification of the benzidine number and shows the percentage of the α and β non-saturated aldegides in the oil, was defined through the Cholmes method, etc. The oil solution spectra in the isooctane were taken on the Unicam 800 spectrophotometre (Britain). Other analyses were made by the standard methods recommended by the All-Union Research Institute of Fats. When seeds were stored the acid number average daily increment was 0.003 mg KOH and that of the peroxide number 0.00004%. The content of non-saturated aldegides grew 2.5-fold during nine months and that of diene compounds doubled. The seeds had no free water and were therefore more spoilt through oxidation processes than through hydrolic ones.

As can be seen from Table 1, the samples studied differed in almost all parameters. In the kernel of seeds damaged during transportation or harvesting (i.e. broken seeds or partially without hull) the acid number was eight times as much and the peroxide number two times as much as in the kernel of healthy seeds. The former had 10 times as many unsaturated aldegides as the latter.

The lipids in healthy kernel had almost 15 times less acid and aniside number than lipids in the dark nuclei and the peroxide number three times less, though the quatity of conjugate double links in the lipids of undamaged seeds was not greater than that in the healthy seeds. The husk's lipids had much more non-saturated aldegides than the nucleus lipids (more than 100 times) and they and especially the lipids of the surface layer had much more diene and triene compounds than both the healthy and damaged kernel. The lipids of the husk and

Table 1

Qualitative Indicators of Some of the Components of the Sunflower Seeds Mass and Tissue

	A.n., mg KOH	P. n., % J_2	An. n. (undefined)	D 0.2% of solution	Oxidation resistance at 100oC, hr
1	2	3	4	5	6
1. Nucleus of damaged seeds	2.86	0.134	2.92	0.55	9.0
2. Nucleus of undamaged seeds	0.37	0.078	0.26	0.72	9.5
3. Extract of whole uncrushed seeds	-	0.347	14.20	2.15	3.8
4. Husk (extract according to Sockslet)	13.0	0.268	37.6	1.26	3.3
5. White nucleus, extract made through drawing (Peredovik variety)	0.67	0.082	0.53	0.64	8.9

Table 1 (continued)

6. Extract of the whole seeds, Peredovik variety	–	0.381	16.7	2.60	3.8
7. Dark nucleus of the Peredovik variety	9.73	0.181	6.70	0.58	3.0
8. Seeds of the production mixture	1.04	0.090	0.67	0.70	8.5

the lipids of the healthy kernel differed sharply in their resistance to oxidation. For the nucleic lipids (of even healthy seeds) the induction period was not less than 8.5 hours, while for the lipids of the husk it was less than four hours.

Thus the present investigation shows that the husk must be separated from the kernel to the maximal extent possible in the process of production. The experimental factories, however, have the nucleic huskness of less than 10%. What is more, there are still proposals to process uncrushed sunflower seeds. The increased huskness of the kernel at the factories is explained by the fact that the oil quality is still not evaluated by the content of the oxidation products.

To obtain the mathematical model of storing sunflower seeds we used the two-level planning method. The model samples of just harvested seeds were stored in laboratory conditions during three months, and these were evaluated by four indicators, the initial oil acid number in the seeds (A. n. in), moisture (W), impurity (C) and storage temperature (t).

The model has the following regression equation for the oil acid number in the seeds:

$$\Delta\overline{A.n.} = 0.094 + 0.039 \frac{W-8}{2} +$$

$$+ 0.017 (C - 1.5) + 0.017 \frac{A.n.in.-2.5}{0.9} +$$

$$+ 0.012 \frac{W-8}{2} \cdot \frac{t - 17.5}{12.5} +$$

$$+ 0.012 (C-1.5) \cdot \frac{A.n.in - 2.5}{0.9} \cdot A.n.j.=$$

$$= A.n.in. \frac{\qquad}{+ \Delta A.n.} \cdot j$$

$6 \leqslant W \leqslant 10$; $0.5 \leqslant C \leqslant 2.5$; $1.0 \leqslant A.n \leqslant 3.5$; $5 \leqslant t \leqslant 30^{o}C$; $0 \leqslant j \leqslant 90$; where $\frac{\qquad}{\Delta A.n.}$ is the daily increment in the oil acid number in the seeds, mg KOH, and j is days of storing.

The model proved adequate when applied to the results of the production experiments of storing sunflower seeds. The comparable research data and the analysis by the Fischer criterion also showed its viability.

The storing of oil. In refined oil the acid number grew by 0.30 mg KOH during eight months of storing; in non-refined pressed oil, on the other hand, obtained at the roasting temperature of 125°C the acid number did not practically change. The peroxide number (P.n.) grew quicker in refined oil and in pressed oil obtained at 150°C and was noticeably lower than in the oil obtained at 105°C and in refined oil. When the oils were stored this difference remained there.

The data on the oxidation stability of these samples of oil show that refined oil is the least resistant to oxidation and the oil obtained at the temperature of 125°C is most resistant. This is confirmed by S. Ivanov's experiments (1971).

Table 2 compares the changes in the quality during the seeds' storing and the oil obtained from them.

In the refined oil the percentage of diene compounds was noticeably lower than in raw oil during the whole period of storing. Diene compounds grew the quickest in the oil obtained under a stiffer temperature regime.

As can be seen from Table 2, the oil's acid number grows more intensively when storing seeds than when storing oil, the increment

Table 2

Changes in the Oil's Chemical Parameters under Storing

Oil type	A.n.mg KOH			P.n_1 % J_2			A.n.(un-defined)			D 0.2% of solution		
	1	2	3	1	2	3	1	2	3	1	2	3
Re-fi-ned oil	0.25	0.55	0.30	0.19	1.08	0.97	2.5	4.5	2.0	0.30	1.15	0.85
Seed oil	0.60	1.26	0.66	0.04	0.14	0.10	0.20	0.67	0.97	0.40	0.85	0.45

1 - beginning of storing;

2 - end of storing;

3 - difference.

being 0.66 and 0.30 mg KOH, respectively. Among the other indicators under investigation that characterise the content of various oxidation products in oil, a more intensive increment was registered in the case of refined oil. This shows that when stored the seeds are dominated by hydrolithic processes and when oil is obtained from them and is subsequently refined (and also when it is stored) oxidation processes prevail. In other words, seeds stored under favourable conditions for a long time (eight to 12 months) can yield oil with a lower content of oxidation products.