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LIPIDS OXIDATION IN SUNFLOWER SEEDS DURING PROCESSING AND STORAGE

The duration of safe storage of raw plant oil and the quality of oil extracted from it, above all resistance to oxidation, are dependable on the character and intensity of free radical oxidizing processes in seeds during post-harvest treatment.

Thermal drying is widely used in processing sunflower seeds. Intensive development of oxidizing processes in the lipide complex of seeds under drying is due to a high initial moisture content of seeds, to a relatively high heating and durability of treatment. Most of authors base the evaluation of oxidizing processes in seeds on the consideration of traditional traits of lipide complex - acid and peroxide numbers, the sum of oxidizing products, unsoluble in petroleum ether. These traits being rather sporadic and accidental cannot characterize the rate of lipide oxidation. For example, the peroxide number of oil characterizes the result of competitive reactions of accumulation and breakdown of peroxide compounds in a given moment. The high mobility of this trait, especially when seeds are treated at high temperatures, does not lead to unambiguous evaluations. Neither is the nature of processes taking place in lipides reflected by the acid number of oil.

That is why, to evaluate the state of lipides of sunflower seeds as an oxidizing system we determined some of its physical and chemical properties (along with traditional traits), such as the antiradical lipide activity making it possible to quantitatively evaluate the capability of the system to hamper the radical formation (Glevind, 1963) and the capability of lipides to

auto-oxidation according to the duration of their reaction with free stable radical DPPH (α, α - diphenyl - β - pikrinhydrazil). The value of this trait depends on the rate of oxidation and lipide unsaturation, on the content of metals of variable valence in the system, and on some other conditions. Using the method of ultra low hemi-luminescence we determined induction periods of lipide hemi-luminescence which characterize the anti-oxidative activity and resistance of lipides to oxidation.

The studies were conducted with sunflower seeds of the Peredovik variety (1973 yield) grown on the VNIIMK fields in Krasnodar. Thermal drying was applied to fresh ripe seeds harvested on the 35th day after the end of flowering with the moisture content of 20-24% and to seeds maturing on plants and harvested on the 52-54th day after the end of flowering they were moistened to the moisture content mentioned above. Heaving temperature was from 42-46°C to 96-110°C. Moisture content after drying was 6-7%. For comparison, the seeds were also dried by sublimation. All seeds were subsequently stored in the laboratory under 75% of the relative air humidity during 28 weeks. Lipide isolation was effected with chloroform-methanol 2:1 mixture. The sum of tocopherols was directly evaluated in lipides without a previous isolation of unsaponifiable matter using the stable free radical DPPH.

Acid, peroxide and tiobarbituric numbers were determined directly in chloroform miscella. The epoxide compounds were directly determined by spectrophotometry using picrate pirydine, and the carbinyle compounds were determined using 2.4-dinitrophenylhydrazine.

In all variants of experiment we have found that the tocopherol content in lipides is dependent on conditions of seed processing, which may influence the tocopherol transfer into the lipide complex of the non-lipide fraction of

seed. the tocopherol loss may also occur as a result of development of reactions of lipide oxidation.

Our studies have also shown that intensive oxidation processes accompanied by hydrolytic processes always take place in lipides of seed under thermal drying.

At early stages of maturation the lipides of sunflower seeds are characterized by high antioxidative properties and high stability against oxidation, whereas the lipides of seeds after thermal drying, especially at high temperatures, are weakly resistant to oxidation during subsequent storage though they have relatively low values of traditional indices of oxidation.

The highest anti-radical activity of lipides was found in seeds dried at 96-110°C the lowest - in seeds after sublimation drying. At the same time, the tocohperols content did not correlate with this regularity. Thus, we may say that tocopherol contribution to the anti-radical activity of lipides does not represent 100% as previously assumed. The highest resistance to oxidation was found in lipides when seeds were dried at 42-46°C and 55-60°C, the lowest - at 96-110°C.

In all cases of thermal treatment we observed an increase in the anti-radical activity of lipides. Methods of seed treatment without thermal processing (sublimation drying, two-phase harvesting) did not stimulate the high level of this activity. But the subsequent storage of unheated seeds revealed a high rate of stability of the antiradical activity of their lipides.

The higher is the thermal intensity under drying, the higher is the intensity of development of lipide oxidation products during subsequent storage. Oxidation resistance of seeds under storage was reduced in all cases.

To explain the results obtaines we must assume that stored oilseeds represent not simply a reservoir of matters able to react, but

a living biological subject in which all metabolic processes are manifest but are strongly inhibited, while their biologically important systems are very conservative.

The living system reacts to external factors by intensitied oxidation processes in the lipide complex. The more unfavourable is the external factor, the larger is the release and transfer into lipides of antioxidants necessary to maintain the stable level of lipide oxidation. But the stocks of antioxidants are limited in seeds that have lost contact with parent plants. When the antioxidants necessary to maintain the stable level of lipide oxidation are no longer available, oxidation becomes uncontrolled and the seeds as a living system, die.

Thus, lipide oxidation in seeds proceeds in the following succession: (1) oxidation activity increase under the influence of the damaging factor, (2) reduction and stabilization of this activity under the influence of antioxidant mobilization as a reaction of organism, and (3) if the damaging factors continue to increase, the separation of oxidation and antioxidation processes and the resultant death of the living organism of the seed.