THE SELECTIVITY OF THE HYDROGENATION OF LINSEED OIL

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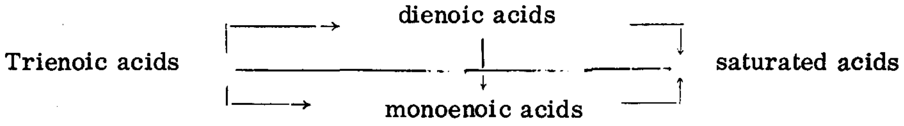
We have investigated the selectivity of the hydrogenation of linseed oil, which is a mixture of triglycerides of fatty acids of different degrees of unsaturation – linolenic, linoleic, and oleic – and saturated fatty acids. Depending on the conditions of hydrogenating oils and fats, the process may go according to the following scheme, given in the literature [1]:



Opinions on the question of the consecutive saturation of triglyceride oils containing linolenic acid are contradictory [1-4]. The linseed oil that we used for hydrogenation had the following fatty-acid composition according to GLC (%): $C_{16:0}$–8.5; $C_{16:1}$–0.4; $C_{18:0}$–2.6; $C_{18:1}$–21.2; $C_{18:2}$–21.0; $C_{18:3}$–46.3. To free it from mucilages, the oil was passed in the form of a miscella through a column of alumina.

We studied the direction of the hydrogenation process as a function of the conditions by analyzing the fatty-acid compositions of the initial oil and of the intermediate and final hydrogenation products. The fatty-acid composition of linseed oil changed when it was hydrogenated in ethanol (at 60°C with 0.05 Pd/Al). The saturation of the oil up to the absorption of almost half of the amount of hydrogen calculated theoretically was accompanied by a sharp decrease in the amount of linolenic acid and a rise in the amount of oleic acid, while the amounts of linoleic and stearic acids remained constant. Appreciable saturation of the linoleic acid was begun only with a fall in the amount of linolenic to 50%. Simultaneously with the hydrogenation of linoleic acid, a marked increase in the amounts of oleic and stearic acids was observed.

When the oil was hydrogenated with 1% of a previously reduced (220-230°C) palladium catalyst at 120°C, again a decrease in the amount of linolenic acid with a simultaneous increase in the amount of oleic acid and constancy of the amounts of linoleic and stearic acids took place. Intensive saturation of the linoleic acid radicals was observed when the concentrations of the latter and the linolenic acid were equal.

Raising the temperature of hydrogenation to 210°C considerably intensified the process, but its direction remained the same as before. We have observed a similar pattern in the hydrogenation of linseed oil with 1% of previously reduced platinum and nickel–copper (1 : 1) catalysts at 120°C.

Thus, regardless of the conditions of the process and of the catalysts, the hydrogenation of linseed oil was accompanied by the preferential saturation of the linolenic acid to the monoenoic acid. Linoleic acid begins to be hydrogenated only after a considerable fall in the amount of linolenic.

LITERATURE CITED

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