

duce central nervous stimulation. There is reasonable ground, therefore, for the opinion that the central nervous systems of arthropods possess certain common features, revealed through the actions of neurophic drugs; and that these features distinguish the arthropod central nervous system from that of an oligochaete.

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Tallowiness in butterfat.

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Butterfat exposed to light and air rapidly takes on an odor and off flavor which has been termed "tallowy." Among the early workers who attributed the tallowiness in fats to the direct action of oxygen are Winckel,¹ Scala,² Ryan and Marshall,³ Vintilesco and Popesco,⁴ and others. Winckel attributes such a state to the action of oxygen upon oleic acid, but he was not able to show the reactions in butter and coconut oil that he showed in other fats. Vintilesco and Popesco were apparently the first to postulate the direct union of oxygen with the unsaturated linkages of fats to form peroxides which readily release their oxygen in the presence of peroxidases, giving reactions with guaiacol.

Smith⁵ favors the view that rancidity is induced by enzymes, while Hunziker and Hosman⁶ attribute tallowiness in butter to oxidation with subsequent splitting and the formation of fatty acids and glycollic acid. Palmer and Combs,⁷ more recently, favor the view that tallowiness in butter is dependent

¹ Winckel, M., *Apothekers Ztg.*, 1905, lxi, 690.

² Scala, A., *Staz. spermi. agric. Ital.*, 1897, xxx, 613.

³ Ryan, L. A., and Marshall, J., *Am. Jour. of Pharm.*, 1907, lxxix, 308.

⁴ Vintilesco, J., and Popesco, A., *J. de Pharm. et d. Chimie*, 1915, xii, 318.

upon the natural oxidases present, while Rogers⁸ concludes from his studies that the changes in butter "is brot about by spontaneous chemical action."

The latter workers mentioned have dealt mainly with factors influencing the rate of formation of tallowiness in butter.

The problem of the oxidation of butter was studied from another standpoint by Dyer,⁹ who measured the rate of disappearance of oxygen in stored butter.

Numerous products of oxidation of butter have been isolated and identified, but the nature of the oxidation which occurs has never been satisfactorily explained.

Results of our work show that the reactions of tallowy butterfat substantiate the view that peroxides are formed. Such fats have the power of liberating iodine slowly from potassium iodide, and the amount liberated in a certain length of time, as shown by the $\text{Na}_2\text{S}_2\text{O}_3$ titre, forms a comparative test of how much oxygen has been absorbed by various fats.

These fats also give the Kreis test, seemingly in direct proportion to the amount of oxygen which they have absorbed. Extreme cases of oxidation have been found, however, in which little or no iodine is liberated from potassium iodide, but the Kreis test is very pronounced. Oxidized butterfats also give a peroxide test with chromic acid when acidified and allowed to stand for a comparatively long time.

It has been found that oleic acid exposed to oxygen for some time will give the characteristic tallowy odor and proportionate peroxide and Kreis tests. Triolein under similar conditions will give an even more characteristic odor and both the named reactions. Its tendency toward oxidation seems less than that of oleic acid.

Unsaturated linkages other than those found in the oleic radical may be involved in the oxidation, but the oleic acid radical is undoubtedly one of the constituents of butterfat largely involved in the production of tallowiness.

⁵ Smith, H. L., *Pharm. Jour.*, 1915, xcv, 4.

⁶ Hunziker, O. F., and Hosman, D. F., *Jour. Dairy Sci.*, 1917, i, 321.

⁷ Palmer, L. S., and Combs, W. B., *Jour. Dairy Sci.*, 1919, ii, 444.

⁸ Bogers, L. A., *Third Internat. Congress of Refrigeration*, Washington-Chicago, 1913.

⁹ Dyer, D. C., *J. Agr. Research*, 1916, iv, 927.