AN IMPROVEMENT ON

THE SWIFT FAT STABILITY APPARATUS*

FOR APPROXIMATING THE END OF INDUCTION PERIOD

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THE length of the induction period in the oxidation of a fat has been extensively used as a measure of the stability of that fat. During this induction period the absorption of oxygen and the formation of peroxides take place very slowly, while at the end of the induction period the absorption of oxygen and the formation of peroxides is very rapid. Both of these facts have been used as tests for determining the length of the induction period.

With the Swift accelerated fat stability test (1) the approximate end of the induction period is determined by the rancid (tallowy) odor from the sample. Then, by determining the peroxide value of the 3 samples of fat which have been placed in the apparatus at hour intervals the exact end point may be determined.

Greenbank and Holm (2) have reported a rapid bleaching of butterfat during the period of logrithmic absorption of oxygen. Briggs (3) has shown that the amount of free acid in the fat is increased during oxidation but is a secondary reaction and does not closely follow the absorption of oxygen. Powick (4,5) has shown that the fatty acids formed from the splitting of the higher molecular weight acids were the lower molecular weight acids and that most of the saturated fatty acids up to C_9 have been identified.

It has been demonstrated in this laboratory that at the end of the induction period for butterfat there is not only a tallowy odor and a rapid bleaching in color, but also a rapid increase in volatile acids distilled over by bubbling air through the fat at 100° C. This latter fact has been applied to the Swift apparatus for detecting the approximate end of the induction period rather than depending upon the tallowy odor.

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METHOD

The exhaust tubes from the fat are connected to glass tubes extending into test tubes containing a suitable indicator as shown in the accompanying photograph. The apparatus shown is essentially the same as that devised in the Swift laboratories (1) except that the oil bath is electrically heated and thermostatically controlled at 100° C. A motor driven stirrer to circulate the oil from end to end is also provided. The alarm clock operates a mercury switch to turn on the heater and stirrer earlier in the morning so that the bath is up to temperature by the beginning of the working day.

A mark is made 10 cm. from the end of the delivery tube and then the test tube filled to this mark so that the back pressure is the same in each tube. In the case of butterfat it was found that, when the color of methyl red changed from yellow to pink, using 1 cc. of N/100 NaOH in each test tube, the peroxide value of the butterfat was approximately 10, the value taken as the end of the induction period for butterfat.

In starting the test 1 cc. of N/100 NaOH is measured into each indicator tube. After the delivery tube has been connected and with the air bubbling through, the test tube is filled with distilled water containing the methyl red to the mark on the delivery tube. It was found more convenient to add the alcoholic solution of methyl red to the distilled water used for filling the indicator tubes than to add the indicator to each tube separately. The indicator was added at the rate of 1 cc. of the regular alcoholic solution to 200 cc. of distilled water, which is equivalent to about 2 drops per tube.

The fat samples are removed

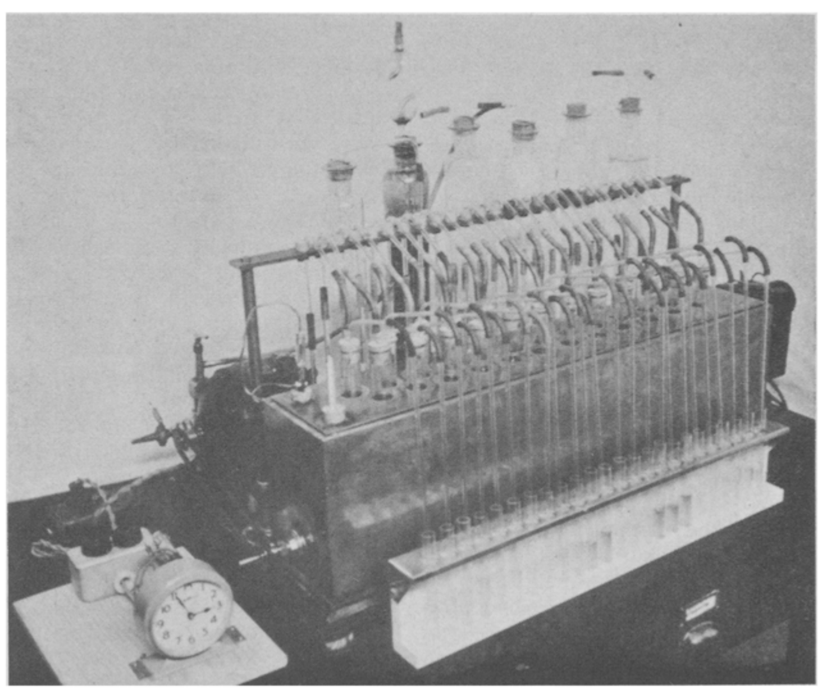

Figure 1—Modification of the Swift accelerated fat oxidation apparatus showing indicator tubes used to show the end of the induction period

when the first indicator tube has turned dark red, showing that the sample is past the end of the induction period. In some cases the second tube will show a color change depending upon the speed with which the sample oxidizes. In any case the samples should be removed before the third indicator tube begins to change color.

The following data on samples of butterfat will serve to illustrate the correlation between the peroxide number and the color change in the indicator tubes:

Sample	Hours	Color of Indicator	Peroxide Number	Stability Value
I.	40½	Red	17.5	
	39½	Reddish Brown	9.5	40½
	38½	Yellow	3.9	
II.	38	Red	16.1	
	37	Yellow	2.7	38
	36	Yellow	2.4	
III.	21½	Red	37.0	
	20½	Red	11.5	20½
	19½	Yellow	2.6	

This method has also been used to a limited extent with lard, olive oil, and corn oil with equal success. The amount of alkali used in the case of butterfat seems to be quite satisfactoy in the case of lard where a peroxide value of 20 is taken as the end point.

In the case of a fat which has developed hydrolytic rancidity the color change may occur within a few minutes after the sample has been started. In the case of butterfat it has been found satisfactory to remove the indicator tubes at the end of the first hour and substitute new tubes with a fresh alkaline solution. The development of an acid reaction in the latter tubes denotes the end of the induction period.

This method of approximating the end of the induction period has the advantage of permitting the operator to check on the samples with a glance at the indicator tubes rather than smelling of the exhaust air from the individual samples. This is especially desirable in cases where the samples of fat vary a great deal in the length of their induction periods or where the odors of the fat tend to mask the odor due to oxidation. It was also found that some experience had to be gained in order to determine the point at which butterfat samples should be removed when judged solely by the sense of smell. This method has the further advantage of promptly indicating any plugged capillary.

BIBLIOGRAPHY

1. King, A. E., Roschen, H. L. and Irwin, W. H.—Oil and Soap, 10: 105 (1933).
2. Greenbank, G. R. and Holm, G. E.—Journal of Industrial and Engineering Chemistry, 16: 598 (1924).
3. Briggs, L. H.—Journal of Dairy Research, 3: 71 (1932).
4. Powick, Wilmer C.—Journal of Agricultural Research, 26: 323 (1923).
5. Powick, Wilmer C.—Journal of Oil and Fat Industries, 1: 63 (1924).

FACTORS THAT INFLUENCE THE ANTIRACHITIC VALUE OF MILK FOR INFANT FEEDING

(A REVIEW)

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ORDINARILY milk constitutes the sole food for infants during the first few months of life. Accordingly it would seem that milk should contain all the constituents necessary to adequately meet the nutritive requirements of an infant. It was formerly believed that breast milk, the natural food for the infant, was the ideal baby food and the results of numerous clinical studies show that its nutritive value is superior to that of foods which have been devised to supplant it. However, when breast milk is not available, reliance must be placed upon some substitute and cow's milk is quite generally employed for this purpose. Unfortunately the composition of cow's milk is not identical with that of human milk. Consequently many procedures have been developed for modifying milk so that it will approximate the composition of breast milk. Nevertheless, in spite of the noteworthy advances that have been made in infant nutrition artificial feeding frequently fails to produce optimum results.

At times artificial feeding is attended by excessive mortality but, even when mortality is not excessive, the growth and physical development of infants may not be completely satisfactory. As a consequence numerous clinical studies and nutritional investigations have been conducted to determine the causes of various types of malnutrition which result from improper feeding. These studies and investigations have shown that rickets is one of the most prevalent forms of malnutrition that result from inadequate infant nutrition. Eliot[1] reports that approximately 86% of babies in a typical American city developed rickets. According to Hess[2] the occurrence of rickets during infancy and early childhood is general in most civilized countries. He reports that in Norway from 32% to 75% of children under two years have rickets. Thirty-five per cent of the breast-fed and 75% of the bottle-fed babies develop rickets in the Faroe Isles. The incidence of rickets varied from 15% to 95% in Russia. It is quite prevalent in Newfoundland, Switzerland, Italy, Sicily, West Indies, China, India, Australia, and it is also not uncommon in Greece, Turkey, Palestine, the Canal Zone, Mexico, South America, Africa and New Zealand.

It has long been recognized that rickets is prone to develop at periods of most active growth; namely, during the first months of an infant's life. Premature, very fat, and large, rapidly growing infants very frequently develop rickets coincident with their active growth.

Rickets is characterized by a disturbance in the equilibrium of the calcium and phosphorus of the circulating fluids, particularly the blood. A diminution of either inorganic phosphorus or calcium content of the blood is probably the first clinical sign of rickets. Hence it is generally believed that of the many factors that may contribute to