THE OVEN TEST AS AN INDEX OF KEEPING QUALITY

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Abstract
The Schaaf or Oven Test, originally developed by the biscuit and cracker industry to provide a relative rating for stability of various shortenings, has been generally adopted by shortening manufacturers. Advantages as well as limitations of the test are enumerated. It is possible to estimate the Oven Test by determining peroxide development in the test sample after four to six days in the oven. Oven Tests may also be conducted without having determined them organoleptically by observing the color change at the point of extreme rancidity. Peroxide formation occurring in a fat contained in biscuits or crackers when subjected to a temperature not greatly above normal temperatures is useful for revealing odors and flavors other than rancidity, which may occur either in the shortening itself or in baked pieces containing it. Some fats develop characteristic odors and flavors due to their nature, while other odors may arise from faulty processing or contamination during distribution. The oven test will in many instances accelerate this condition if it is likely to develop as the shortening ages under normal usage. Such factors are not brought out by other accelerated stability tests.

Most of you are familiar with the procedure employed, or some variation of it. The oven should preferably be of the convection type capable of maintaining a uniform temperature of ± 0.5°C, and located in a room free from odors. The temperature must generally be about 63.0°C. Ovens of the forced circulation type can be used without materially changing the results obtained, but tend to make the detection of the initial stages of rancidity development more difficult.

A sample weight of 50 grams is a convenient amount. An ordinary Griffin low form beaker of 250 ml capacity, with or without lip, provided with a three-inch watch glass for a cover is a suitable container. The glassware must be scrupulously clean. The usual mixture of potassium dichromate and sulphuric acid may be used for cleaning, but it is not necessary. This mixture is not easily removed from glassware and even minute traces of it remaining in containers used for the oven test will certainly lead to erroneous evaluation of stability. Thorough washing with soap and water plus careful rinsing in distilled water, and drying, without wiping, in a heated cabinet is a much more dependable procedure.

The test samples should be smelled daily, preferably in the morning when the nose is keenest, for the development of a rancid odor. It is essential that the watch glass be kept on the beaker at all times except when actually smelling the sample, and the sample should be smelled immediately after removal from the oven. Usually as the end of the induction period approaches, the sample darkens in color, at which stage organoleptic rancidity soon becomes evident. The oven test is reported as the number of days required for the characteristic rancid odor to manifest itself.

Throughout the procedure the utmost care must be exercised not to change in some manner the inherent stability of the sample under test. This involves such well-known factors as freedom from any contamination, particularly metallic, avoiding overheating if the sample must be melted for preparation, and unnecessary exposure to light. With precautions taken for the elimination of any factors which tend to alter the normal keeping quality, then the stability of the shortening becomes a function of the oven temperature. For this reason the temperature must be carefully controlled within narrow limits. Also, to further the maintenance of a uniform temperature the oven should not remain open any longer than is necessary for inspection of the samples.

It is possible to estimate the oven test using peroxide formation as the index. To do this a curve must be plotted showing the course of peroxide formation during the oven test. Any one kind of fat which has been subjected to the same processing conditions will nearly always develop organoleptic rancidity at a fairly uniform peroxide concentration.

The length of time required to reach this concentration is determined by the rate of peroxide formation, which in turn is governed by the stability of the particular sample. Thus, if the peroxide con-
because they become rancid so cidity occurs. Fats with shorter the point at which organoleptic ran-
quickly at the end-point that there induction periods are easier to judge daily inspection. Those with long-
er oven tests are more difficult be-
changes place under conditions em-
employed in more rapidly accelerated methods.

As the end of the induction pe-
period is approached the color grad-
ually darkens and rancidity soon becomes evident. If the test is con-
tinued beyond this stage to extreme rancidity the color will generally become lighter and this change oc-
curs quickly, frequently overnight. Thus, the darkening in color may serve to indicate rancidity is ap-
proaching. A further reduction of personal variation can be effected on the basis of color change by carefully determining the end-point which would ordinarily be report-
ed as the oven test, and then con-
tinuing the test until the sample becomes lighter in color again. The interval in days between the nor-
mal end-point and the point where the color lightens can be applied as a minus factor on future sam-
ple which are carried to this same color change. In this way it is possible to conduct oven tests with-
out having actually determined them organoleptically once the pre-
liminary data has been established. This procedure is helpful in reduc-
ing variations in judgment of the individual, but like using peroxide data for estimating the oven test must be used with care. The fac-
tors to apply will vary with the type and brand of shortening, and also with the length of the oven test. For example, a fat with an oven test of twenty days may run twenty-two days before the color lightens and require a factor of two, whereas a fat with an oven test of forty days may require a factor of four or five days.

One other limitation of the oven test is the length of time required to complete the determination. It has been discussed how peroxide formation during the early stages of the oven test can be utilized to obtain some idea of the indicated keeping quality. There are several modifications of the Schaal Oven Test, all of which tend to accelerate the test and decrease the time of the determi-
nation. Some of these modifica-
tions employ the use of higher tem-
peratures, others the use of absorb-
ent materials to increase the surface of the fat exposed and still others in which a controlled amount of a pro-oxidative substance is added to the sample in order to increase the rate of oxidation.

Correlation of the keeping qual-
ity of a shortening, and biscuits or crackers containing it, by means of the oven test has been the occasion for much investigation. Baked pieces from commercial production or those prepared by the laboratory show a fair degree of correlation with the original fat, though the oven test of the baked pieces is as a rule of shorter duration. In some instances the relationship is very irregular. There are several ex-
planations for these differences. Even with the best of handling in the laboratory or in the factory, variables are introduced which cannot be completely controlled. Pro-
oxidative effects are incurred, such as metallic contamination in mov-
ing through production equipment. Also, the effect of the ingredients used is a variable. Some tend to exert a preservative action while others behave in the opposite man-
ner. The greater surface area of the fat exposed to the air in the baked piece as compared with that of the fat when tested alone will contribute to differences in values for stability. One of the most im-
portant considerations is whether or not the shortening contains an antioxidant, and if it does, is its

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