Microbiological Method of Assay for Certain Fatty Acids

It should be emphasized that when the nature of the fatty acid is known and the pH is controlled, the bactericidal activity of the fatty acid, *e.g.*, with *Staphylococcus aureus,* may be utilized as illustrated in Figures 1 and 2 in order to assay for micro quantities of the individual acids especially in the C_9 to C_{12} range. For example, since undecylic acid possesses a killing dilution of 1:88,000 at a pH of 3, 8.8 ml. of solution will contain 0.1 mg. of the acid. Thus under these conditions, if 10 ml. of a solution would require a 1-88 dilution to reach the highest killing dilution, then a total of 10 mg. of undecylic acid would be present in the original solution.

Other Bacteriological Applications

Previous workers (28) have demonstrated the usefulness of a lauryl sulfate-tryptose broth for detection of coliform organisms. It is quite possible that certain dilutions of fatty acids at various pH's might also give selective media for differentiation and isolation of certain microorganisms. However the concentration of fatty acid should be sufficiently high to account for possible combination with proteins present in the media.

Other practical applications resulting from the bactericidal activity of fatty acids can best be applied by workers in their respective fields.

Summary

Fatty acids in the C_9 to C_{12} range are bactericidal to a number of different organisms, and this activity is markedly enhanced with increasing acidity. Optimum bactericidal activity to *Staphylococcus aureus* was exhibited by undecylic acid. Since the activity is of the same order as that of the quaternary ammonium germicides in alkaline solution, an explanation for both types of germicidal activity is presented in which the bacteria or some protein essential to the bacteria are considered to be "suffocated" by a "coating" of fatty groups in chemical combination with the protein.

The application of these findings to bactericidal activity encountered in rancid fats is discussed briefly in connection with the oxidative degradation of oleic acid derivatives to pelargonic acid. In addition, the possible usefulness of the bactericidal activity as a microbiological assay method for certain fatty acids is pointed out.

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[Received October 20, 1953]

A Laboratory Tool to Study the Plodding Characteristics of Soap Formulations

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RECENT introductions to the consumer market of bars based partly or wholly on synthetic detergents indicate the interest of soapers and others in solving the age-old problem of lime soap formation which has plagued the users of classical soaps wherever waters containing relatively small amounts of hardness occur. Those who have attempted formulations of an all-synthetic or soap-synthetic bar have been struck by the changes in physical appearance of the plodded bar that take place when small amounts of some compounds are added, for example, sodium chloride. The introduction of some organics produces what appears to be a desired improvement in the milled flake, but subsequent attempts at plodding the improved flakes are fruitless because the mass fails to coalesce to homogeneity as evidenced by feathering, cracking, and friability of the plodded bar.

In view of the consideration that we had at our disposal no reliable screening technique for plodder bar character, it was mandatory for us to rely on pilot plant equipment for every evaluation. Since the minimum requirements of this machine are about 10 lbs. of product, the method proved to be timeconsuming, costly, and in some instances, due to a limited supply of materials, it was impossible to make an evaluation.

The purpose of this paper is two-fold: a) to reveal a simple laboratory method for plodding soap or soap-plus combinations adaptable to small samples of approximately 100 g.; and b) to show the effects of some additives on the appearance of the plodder bar.

Experimental

The retaining head and spring pressure assembly of a standard laboratory size Schaar hand-homogenizer was removed so that when a plug of soap was placed in the one-half inch diameter cylinder and forced through and out of the one-sixteenth inch orifice by the piston, it emerged in the form of a "wire" whose surface and body characteristics were in striking parallel to the conventional plodder bar. Figure 1 illustrates the extrusion method.

In order to determine if "shortness" due to low moisture could be recognized and evaluated by the miniature technique, the following was done. To several 100-g. quantities of dry soap was added successively increasing amounts of water so that each sample would have a higher moisture content than the previous batch. Each well-mixed batch was milled exactly three times on the same mill setting and pressed into a crude bar form by means of a hand-operated press. These bars were placed in moisture-proof containers, and the moisture content of each bar was determined by standard methods. A cylindrical plug was cut from the bars with a cork borer, placed in the cylinder of the homogenizer, and extruded. Results were as indicated in Table I, showing the effect at three moisture levels.

The flow pressure values indicate that power requirements increase as moisture content is reduced,

TABLE I

Plodding Characteristics at Three Moisture Levels

Sample No.	Percentage moisture	Flow pressure[a]	Appearance
1	12.6	225	A
2	11.2	248	B
3	10.2	292	C

[a] Flow pressure = yield pressure + 25 lbs. p.s.i.
A = No feathering, no breaks
B = Slight feathering, few breaks.
C = Profuse feathering, many breaks.

a condition well recognized in plant production. The indicated degree of change in appearance of the extruded wire of soap illustrates the capability of the method to detect the effect of relatively small changes in moisture content.

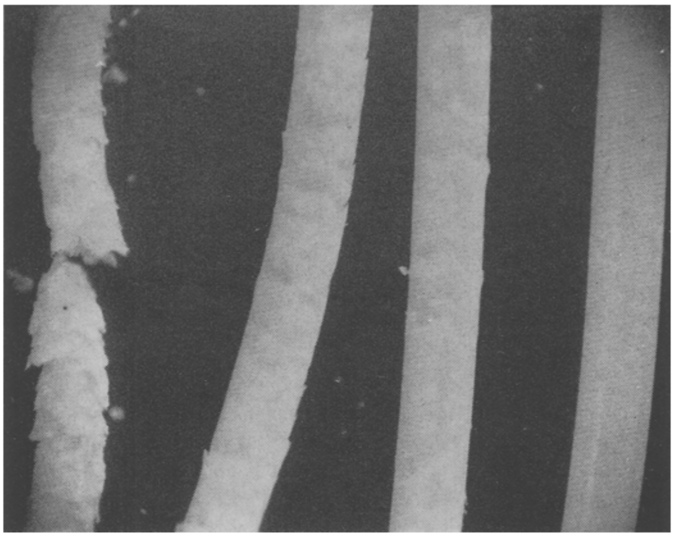

FIG. 2.

Figure 2, a 6× magnification of extruded soap, illustrates a range from extreme shortness to homogeneity in four steps. When the material is extremely short, feathering is so severe and deep that the material breaks into numerous and small lengths. Somewhat longer materials still feather badly but hold together at least until flexion is attempted, whereas a "long" product has high surface luster in conjunction with fair to excellent flexion tolerance. Shortness due to the presence of excess sodium chloride was evaluated in a like manner. Data are recorded in Table II. It should be noted that observed changes in appearance are in evidence by even so small a difference in sodium chloride content as 0.15%.

TABLE II

Plodding Characteristics at Three Salt Levels

Sample No.	Percentage moisture	Percentage NaCl	Appearance
4	13.4	0.73	A
5	13.3	0.88	B
6	13.5	1.03	C

A = No feathering, no breaks.
B = Slight feathering, few breaks.
C = Profuse feathering, many breaks.

By the following procedure further testing of the technique was carried out to ascertain its ability to differentiate true length from false length where a flake with false length is defined as one having all of the tensile strength of the true "long" flake but seriously lacking in its ability to coalesce to a homogeneous form when plodded.

A quantity of soap containing sufficient salt to make pilot plant (and full scale plant) plodding difficult was divided into three parts. The first was milled and pressed into bar form and used as the control. To the second aliquot was added an organic compound which had proved from past experience to be capable

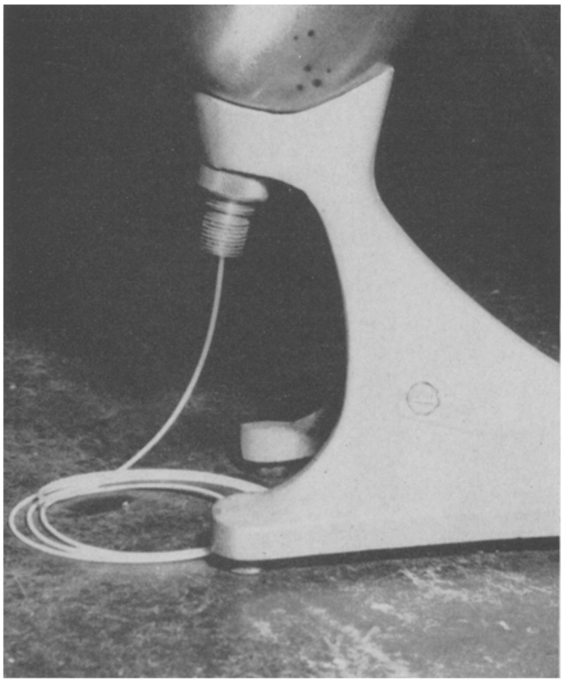

FIG. 3.

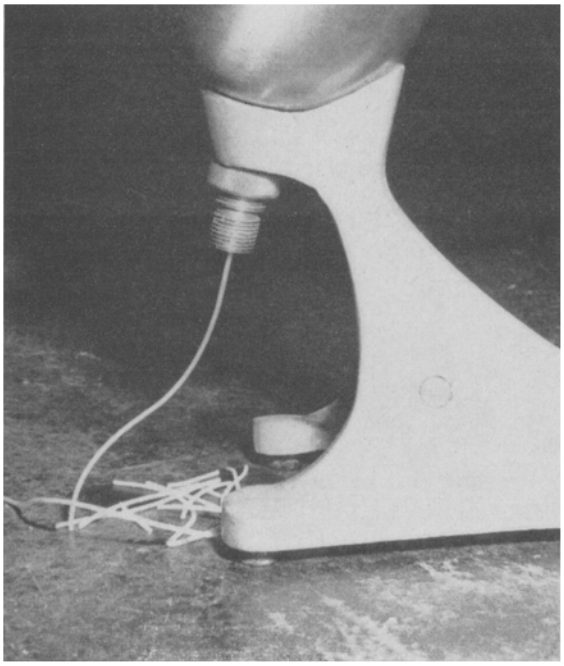

FIG. 4.

of overcoming shortness and thereby produce a long flake which would plod well. To the third aliquot was added another organic whose contributing factor was one of false length, subsequently reducing the plodding characteristics to one of impossibility. The extrusion of these three samples in the homogenizer gave results paralleling those found under actual plodding conditions. The ability to be extruded in wire form was completely lacking in the sample containing the organic which provided false length, the control slightly feathered and broke four or five times, and the sample containing the true lengthening agent was extruded in a homogeneous form.

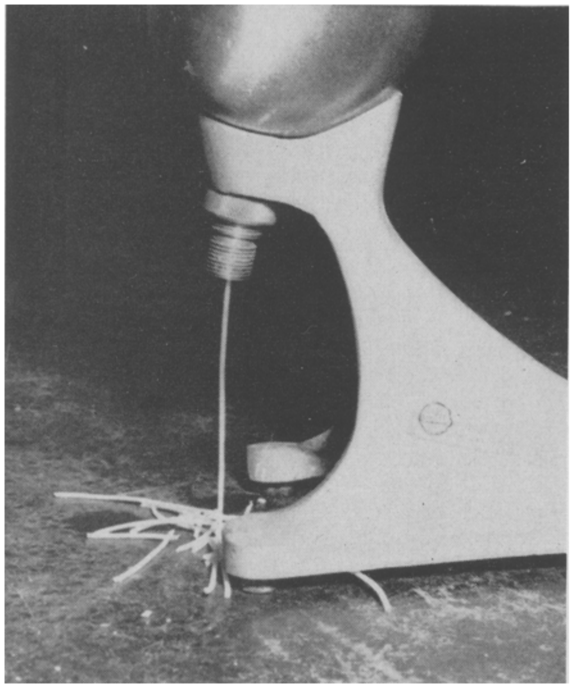

FIG. 5.

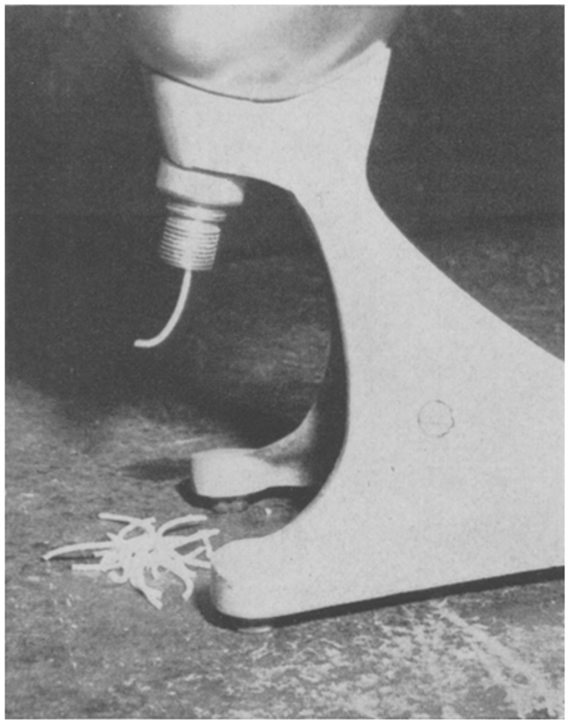

FIG. 6.

Figures 3 through 7 illustrate the changes in appearance of the extruded wire of soap due to increasing degrees of shortness and/or false lengths. Figure 3 illustrates a "long" flake, which when extruded has good flexion and high surface luster. A change in flexion tolerance is illustrated in Figure 4, and surface luster was also slightly reduced. Failure to initiate bending and short broken lengths of the extruded soap shows a still greater degree of shortness in Figure 5. At this point surface luster is just about non-existent.

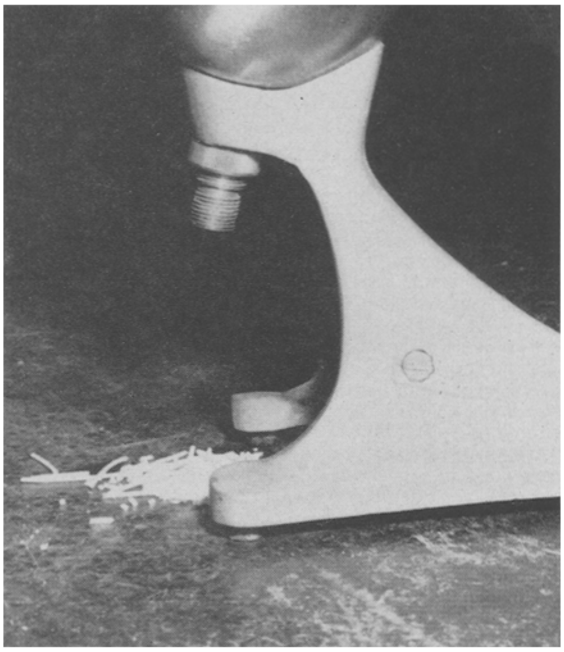

FIG. 7.

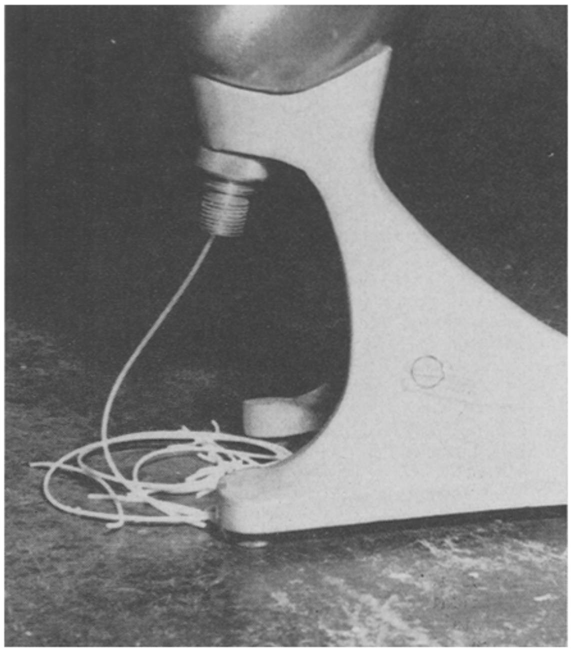

FIG. 8.

Figures 6 and 7 carry this shortness two additional steps.

Discussion

A standardization in the technique of the operator is as important using this method as it is in any analytical procedure. Flow pressure, for example, must be kept constant throughout the time interval of extrusion. Pressure substantially beyond those necessary to initiate and maintain flow at a reasonable rate are in the direction of putting more work into the system. The correlation here with plant experience is good. When more work is done on the plodder bar in the plant, a better bar surface results. Similarly when excessive pressures are used in the laboratory equipment, a smoother wire results.

Figure 8 demonstrates the change which can take place in those systems benefitted by higher back pressures. In this particular case the first half of the material was extruded at yield pressure plus 25 lbs. p.s.i. Under these conditions flexion tolerance and luster was poor, as illustrated by the broken lengths. The latter half of the extrusion was carried out at approximately double the former pressure with subsequent improvement in flexibility and surface luster.

The application of heat to the orifice head by one means or another has produced drastic changes in extrusion pressures and appearance. It is felt however that accurate and precise information regarding the specific changes due to heat are beyond the scope of so simplified a testing procedure even though trends are observable.

Attention should be called to the fact that the method is not empirical in nature. If however the operator will standardize his technique of operation, then any change in extrusion character due to formulative variations may be recognized as a contrast to the control.

We believe it worthy of mention that all of our pilot plant and plant scale plodder bars have proven the accuracy of changes predicted by this method.

The equipment requirement will consist of:

1. Any roller mill capable of milling a soap flake.
2. A press for compacting the milled flake into a solid form.
3. A Schaar hand-homogenizer or a home-made piston-plunger-orifice apparatus that will extrude soap.
4. A set of weights or spring scale so that yield and flow pressures can be determined.
5. A maximum of 100 g. of product to evaluate.

Summary

A simplified laboratory size scale technique has been outlined for use in the study of plodding characteristics and changes therein due to formulative variations. The quantity of product needed for evaluation being in the range of 50 to 100 g.

[Received November 6, 1953]

Correction

The street address given for Rozier D. Oilar, author of the paper entitled "Several Rare and Uncatalogued Oils of Ecuador," which appeared in the April 1954 issue of the Journal of the American Oil Chemists' Society (*31*, 142-143), was not correct. It should read 1213 N. Grant street, West Lafayette, Ind.