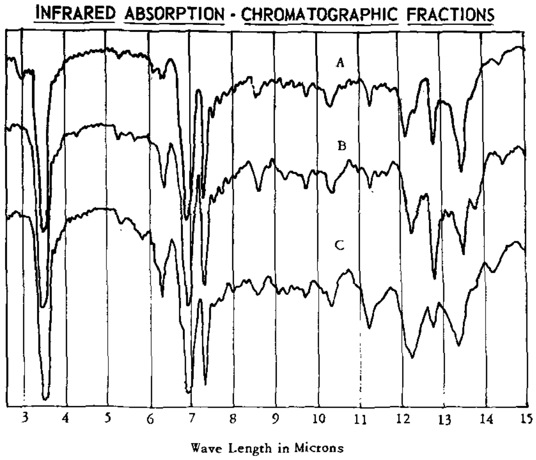

FIG. 4. Infrared absorption curve of toxic principle isolated by chromatographic procedures.

However the concentrate was known not to be a pure compound so these values are only indicative of general structures.

The material toxic to chickens does not show cortical steroid hormone activity. The test animals were adrenalectomized rats, and a modified Kagawa test was used in the assay.

Brew *et al.* (14) concluded on the basis of information available that the toxic material is probably a result of the alteration of cholesterol to a hydrocarbon compound or series of hydrocarbon compounds with some oxidized forms possibly having toxic properties. The molecular weight from mass spectra data indicates that a cholestatriene isomer could possibly be the toxic compound. However further work on the structure of the toxic compound is necessary before a final decision can be made as to the exact structure of the toxic material.

In summary, the following points may be emphasized: a) the toxic material is found only in certain lots of fat subjected to special fat processing operations and fat *per se* is not involved in the toxicity; b) steps have been taken by the feed industry to prevent the incorporation of fats containing the toxic principle into feedstuffs. At the same time research is being carried on to determine the structure of the toxic material so as to enable the feed industry to have a more precise control over fats destined for use in animal feeds. The research work on this problem has been an excellent example of cooperation between industrial, university, government, and private laboratories.

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[Received January 19, 1959]

A Study of the Continuous Production of Mayonnaise

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OVER THE PAST TWO DECADES all aspects of the vegetable oil industry have been transformed slowly from an assembly of batch processes, wherein operator experience played a key role, into a mechanized industry of truly continuous and automatic operation. This trend has been particularly marked in the areas of oil extraction, refining, deodorizing, and in the finished-product lines of margarine manufacture. Mayonnaise production however has been somewhat slower in following this trend although the elements of fully continuous operation have been available for some time.

During the late '30's mayonnaise manufacturers began to use the colloid mill as a means of speeding up the final fixing of the mayonnaise emulsion. Since that time essentially all the major producers have switched to this equipment, and its value is now well established. Even so, the blending of mayonnaise base and its preparation for continuous milling have remained a batch system in most operations throughout the country. This blending is considered an art, jealously protected, but nearly every plant will admit that a good product is made "most of the time" with occasional breakdown of the emulsion into a complete liquid system without apparent reason.

In an attempt to develop a truly continuous plant, from metering the basic raw ingredients to the final milling, a cooperative program has been set up between the Torresdale Company of Philadelphia and the Manton-Gaulin Manufacturing Company of Everett, Mass. This paper should serve to outline the problems and the methods used to establish proper solutions. Basically there are three problems.

First, all materials must be metered accurately in spite of changes in physical properties. Moisture in the air must not affect metering rates of dry ingredients, viscosity must not affect oil flow rate, and, most important, emulsion stiffness must not alter transfer of uniform product-weight from point to point in the process.

Second, blending of oil into the base mixture is most delicate. The rate must not exceed the absorption rate of oil into this emulsion, or a complete breakdown will take place. To maintain an exact and specific phase condition at all times by blending into a mass of properly stable emulsion would seem necessary for success.

Third, materials of construction play an important role in holding emulsions in proper phase. Wetting out caused by areas of oil boundary conditions can destroy the most meticulously prepared complete base in the colloid mill.

To solve the first problem we find that dry ingredients meter well by means of a Syntron Vibratory Elevator. Sugar, salt, and mustard flow from such a system with uniformity regardless of conditions. Each ingredient can be metered accurately within 3% of the value required. This value is reproducible from dial setting at any time. An accuracy in this range reflects in a formulation accuracy of better than 1/10 of 1% for these ingredients. A 5 to 1 change in plant rate can be obtained by dial setting. Powdered egg cannot be metered in this way.

Liquid ingredients are metered by means of constant-volume pumps, which do not suffer from viscosity changes inherent in rotameter or orifice metering.

The most important aspect of metering involves transfer of base and emulsion from point to point in the process. To solve this we have adapted a continuous weight system. Figure 2 shows this system schematically.

Material is pumped to a mixing hopper mounted on a beam balance scale. From the bottom of this hopper the mixture is pumped in a recirculation line at a rate between 1½ and 2½ times the plant capacity at this point. A flow diversion valve in the recirculation line sends part of the flow forward to the following process stage. So long as the weight of material in the mixing hopper is correct, as called for by the beam balance arm-sliding weight, an air pilot valve operated by the balance beam maintains proper split flow by control on the diversion valve diaphragm. Any under-weight or over-weight, which is evident by movement of the balance beam, results in movement of the air pilot valve and readjustment of flow in the recirculation line automatically.

This system holds level in the mixing chamber to within ⅛″ and provides a fixed mass of material regardless of air contents or viscosity.

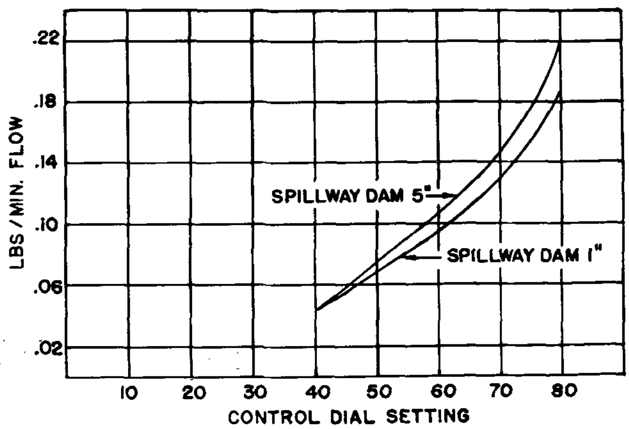

FIG. 1. Continuous conveying of salt (sodium chloride). Unit is Syntron Vibratory Elevator, Type EBOO.

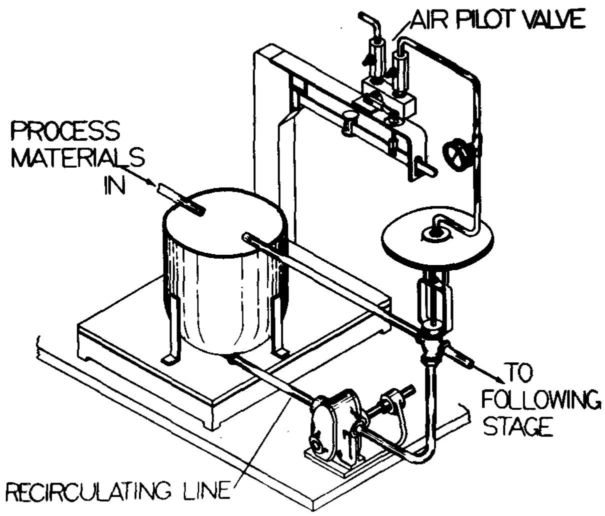

FIG. 2. Scale.

The second problem, namely blending in proper phase conditions, is solved by applying these weight systems. The primary base containing egg, water, vinegar, sugar, salt and mustard is quickly blended without phase problems in the first weight mixer. Hold-up time is adjusted to insure thorough dissolving of sugar and salt and the mixing energy is adjusted to entrain more or less air as desired. From this first stage emanates a fully prepared base ready to receive oil.

A second weight system is provided wherein a primary base and approximately one-third of the oil are blended in proper emulsion phase. It is found that, so long as the phase is proper and slightly over one-third of the total, oil is already blended, new oil and new base can be added continuously without reverting the phase if the blending rate is held below a fairly loose ratio of blending rate to hold-up volume.

Having prepared a complete base by this means, the colloid mill is now applied on a truly continuous basis. The Gaulin Mill is unique in that flow of material is directly counter to centrifugal force, of self-pumping tendency, thereby allowing external pump control of residence time in the mill. Figure 3 shows this feaure in detail. Material is fed into the impeller at the center, thrown to the outside diameter where

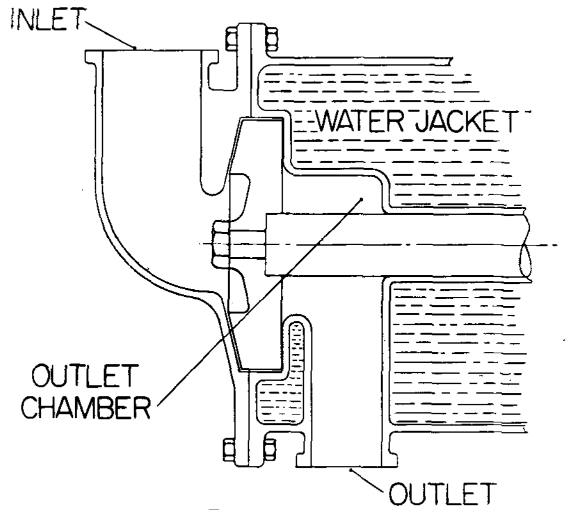

FIG. 3. Mill.

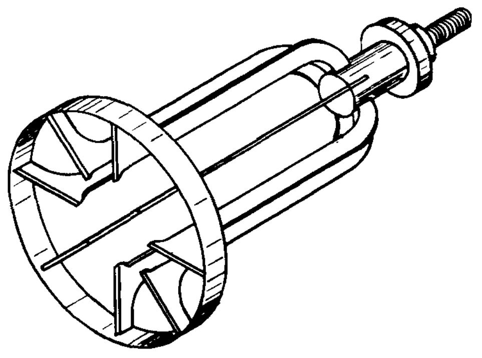

FIG. 4. Knife.

it is forced downwards to the milling faces. These milling faces are perpendicular to the axis with material forced inward against centrifugal force in order to pass through the zone of high-shear-force energy. The mill, operating on mayonnaise, requires external pressure to obtain proper feed rates although in many industrial applications the integral impellers supply this pump pressure. During the experimental work it was necessary on many occasions to cut the mill speed to one-half its normal operating speed since sufficient capacity was not available to feed material at adequate rates.

For standardization purposes we have adapted the Gaulin Curd Tension Meter to mayonnaise in order to measure stiffness of final product. This instrument drives a knife-edged grill (Fig. 4) down through a sample at a constant speed of 8 in./min. and measures the resistance in grams offered by the sample to this standard grill, moving at this constant speed.

Figure 5 shows the effect of changing the colloid mill settings while holding formulation and plant capacity constant. Note that the stiffness levels off below .010 in. separation of the mill faces but that mayonnaise can be made, at least on this formulation, with settings up to .020 in. Tests were made by changing settings while the mill was running on a single complete base, a procedure made possible by the Gaulin design.

After measuring these samples, identical samples were shipped 400 miles and held under shelf-storage conditions for one week. The effect of time on this mayonnaise is shown.

By way of comparison three brands of mayonnaise were obtained locally and measured with the same equipment. These results are shown in Figure 6. Note how much more stiff mayonnaise can be made if the market were available.

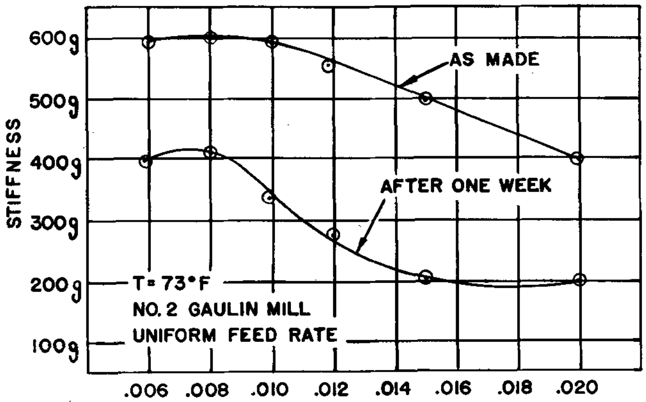

FIG. 5. Mill separation.

By use of this continuous system and the Gaulin mill we have been able to expand our formulation quite radically. We have dropped from 78% oil to 65% oil without changing egg percentage and have been able to drop the egg content 3% without addition of more oil. In each case color has been affected, but an acceptable product can be made.

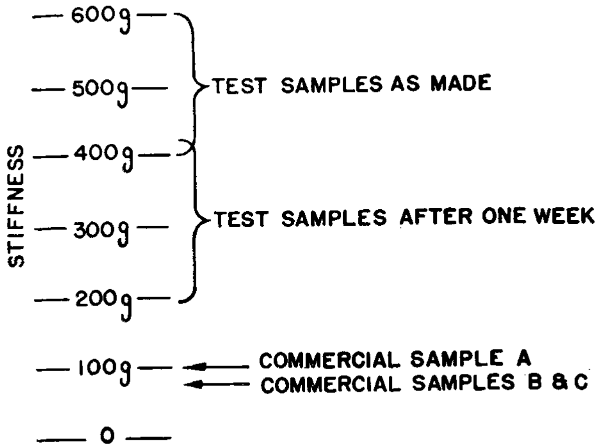

FIG. 6. Comparison of mayonnaise samples.

The advantages of such a system are as follows: a) truly continuous operation reduces equipment size, thereby effecting savings in investment; b) product uniformity is assured with use of minimum formulations, thereby effecting raw-material savings; and c) operator training-time is markedly reduced, and relatively little attention is required from operator.

[Received November 28, 1958]

Isolation of Vernolic Acid from *Vernonia anthelmintica* Oil

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VERNOLIC ACID, the chief fatty acid of *Vernonia anthelmintica* seed oil, has been characterized by Gunstone (1) as *cis*-12,13-epoxy-*cis*-9-octadecenoic acid. This acid has also been shown by Bharucha and Gunstone (2) to occur in the oil of *Cephalocroton cordofanus,* and by Chisholm and Hopkins to occur in oils of *Hibiscus esculentus* (3) (okra) and *Hibiscus cannabinus* (4) (kenaf). Despite Gunstone's thorough degradative work on vernolic acid and subsequent stereochemical work (5) on glycols derived from it, the isolation of this compound in the free state, with its epoxy group intact, appears never to have been reported in the literature.[1]

[1] Just as this work was being completed, the authors were informed that C. Y. Hopkins and M. J. Chisholm had submitted to this journal a manuscript describing isolation of vernolic acid from *Hibiscus cannabinus* by a somewhat similar method.