TABLE III

Component Fatty Acids of Coffee Oil

Fatty Acid	Weight %
Palmitic	32.0
Hexadecenoic	0.9
Stearic	7.6
Oleic	8.2
Linoleic	46.3
C_{20} and above	5.0

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Summary

A specimen of coffee oil has been examined with the objective of determining its composition in the light of possible uses of the oil which is recoverable as a by-product in the soluble coffee industry. The oil, as obtained by extraction of the coffee grounds with solvent, contains over 5% of unique unsaponifiable material which, without preliminary removal, makes the oil unsuitable for many purposes. It has been shown that the unsaponifiable and glyceridic components can be separated by molecular distillation.

A specimen of the methyl esters of the fatty acids of the oil was examined by the ester distillation fractional crystallization techniques. The composition of the component fatty acids has been calculated. The oil contains 46% of linoleic acid. Saturated and unsaturated acids of the C_{20}, C_{22}, and C_{24} series are present in coffee oil in small amounts.

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Edible Spreads of Wide Plastic Range From Vegetable Oils and Monoglycerides[1]

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A problem of the Quartermaster Food and Container Institute for the Armed Forces to which attention has been invited is the development of a spread for bread to be used in combat rations. This fat spread is required to be plastic at the low temperatures of the arctic regions and yet not to melt or separate in the tropics. An obvious solution, one spread for the tropics and one for the arctics, is not feasible for many reasons of military supply. Since our men are stationed in all parts of the world, there is a need for what we characterize as a "global edible spread."

First attempts to prepare spreads of wide plastic range followed the formulation of the wide viscosity range lubricants used by our Armed Forces in Sperry gyroscopes and instruments of the sort. By the use of edible counterparts of ethyl sebacates and lithium soaps, a wide plasticity range fat spread was indeed obtained. A mixture of ethyl esters of soybean fat acids and of calcium soaps properly chilled could be spread at —10°F. and yet retained shape at 140°F. Poor flavor and oxidative stability seemed insurmountable in this product, to say nothing of the questionable merits of feeding the unsuspecting soldier 10-15% of calcium stearate which he could not metabolize.

In the subsequent search for nutritionally acceptable ingredients, mixtures of vegetable oils with relatively large proportions of saturated monoglycerides were found to give solids which possess desirable plastic properties. This composition is the basis of what is described as a global spread. A typical composition is presented in Table I. To the mixture of monostearate and vegetable oils is added antioxidants, vitamins, butter flavor, color, and salt. Because no water is present, no separation of water phase can occur. Because of the lack of water on the other hand, the

TABLE I

Composition of a Global Spread

Ingredients	Parts
Soybean salad oil	84.0
Distilled monostearate	16.0
Salt	3.0
Butter color concentrate [a]	0.2
Butter flavor concentrate [b]	0.2
Propyl gallate	0.01
Citric acid	0.005
Vitamin A	16,500 units/pound
Vitamin D	3,300 units/pound

[a] A mixture of 40% F.D.R.C. butter yellow No. 3 and 60% F.D.R.C. butter yellow No. 4.

[b] "Butr-trate W" made by E. R. Mollner Company, Los Angeles, Calif. The mention of this product does not imply that it is endorsed or recommended by the Department of Agriculture over others of a similar nature not mentioned.

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salt must be incorporated in a finely divided but solid state.

Plastic range of this spread is greatly improved over currently available spreads for bread. It can be spread with ease at 32°F., and it maintains its form at 110°-130°F. Shown in Figure 1 are penetration

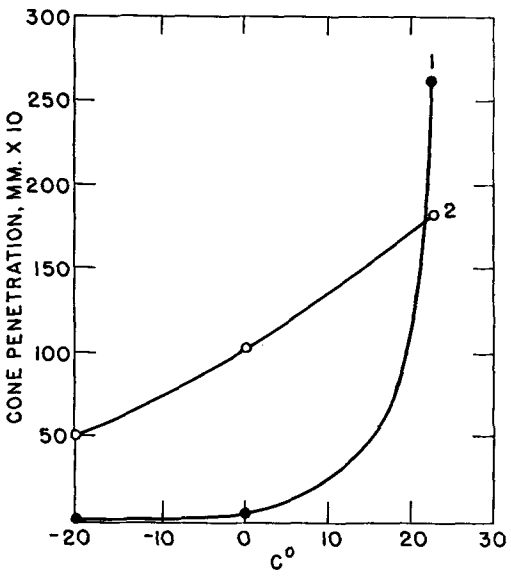

FIG. 1.

values versus temperature for a commercial margarine and a global spread. The minimum penetration permitting spreading is approximately 5 mm. This value is reached by margarine at a temperature of 60°F., but by the global spread at a temperature of —4°F. At temperatures higher than 72°F. the global spread is more firm than margarine.

A variety of vegetable oils may be used successfully in this formulation. Some of them are listed in Table II. Little difference in penetrations is observed to result from the use of the various oils, except in the case of olive oil. These penetration values, in millimeters, were determined after tempering one week with a grease cone of the standard A.S.T.M. design except that its weight was 93 g. instead of 150 g. Olive oil penetrations were significantly lower at 34° F., perhaps due to the crystallization of the oleins present. Hardened fats such as margarine oil may be added up to 20% without appreciable impairment of low temperature plasticity. The same limit of 20% appears to apply for the addition of butter oil. Aside from a current interest in finding new uses for dairy products, the use of butter oil in these formulations appears to have a legitimate function in supplying flavor characteristics to the product.

TABLE II

Effect of Various Oils upon Penetration

Oil	13% Monostearate		18% Monostearate	
	75°F.	34°F.	75°F.	34°F.
Soybean	22	18	16	14
Cottonseed	22	17	17	12
Corn	20	16	16	11
Peanut	22	18	16	14
Olive	22	13	....	....

The hardness of global spreads can be controlled as shown in Table III by varying the monostearate content; the higher the monostearate percentage, the harder is the product. An upper limit is imposed by spreadability and waxiness in the product and a lower limit by a tendency of the oil to separate at temperatures of 110°F. or the like.

TABLE III

Effect of Monostearate Content upon Penetration in Cottonseed Oil Spreads

% Monostearate	Penetration (mm.)	
	75°F.	34°F.
13	23	16
15	21	15
18	17	12
25	11	7

Unsaturated monoglycerides have been tested and have no beneficial function insofar as has yet been discovered. Saturated monoglycerides of shorter chain length have been incorporated and may eventually have a place in the formulation. However monolaurate (also coconut oil monoglycerides) has inherent undesirable flavor and nutritional characteristics. Monopalmitate added at normal levels did not give a plastic solid. For reasons of availability and performance, monostearate will probably continue to be of most general interest. While distilled monostearate has most frequently been used and has the advantage of high purity, satisfactory spreads have been formulated with the equilibrium mixture of mono- and diglyceryl stearate.

Work on global spreads at the Northern Laboratory has gone into the pilot plant phase. Ingredients of the formula are mixed and heated to 160°F. in a steam-jacketed kettle. After melting, the mixture is pumped into the A section of the pilot plant Votator. Nitrogen is (20-25% by volume) bled in just ahead of the pump and gives a margarine-like texture to the product. Because global spread is a thioxtropic material, it flows as it issues from the Votator and permits the filling of cans such as are used for packaging the combat rations.

The development of global spread is by no means completed. Much needs to be done to improve the "mouth feel," the "get-away," synthetic butter flavors, and the oxidative stability. These problems are the areas of current investigations.

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