SUPPLEMENT

It is felt that the derivation of the equation used for estimating glycerol recovery in the full countercurrent system will be of value. This is given below:

Let L = fraction of free glycerol in kettle removed by first wash

M = fraction of free glycerol in kettle removed by second wash

N = fraction of free glycerol in kettle removed by third wash

a = glycerol in niger

s = glycerol bound in unsaponified portion of fat charge in first change

y = glycerol in the lye from a second change

z = glycerol in the lye from a third change

R = fraction recovered of available glycerol in the fat charge

1 = available glycerol in the fat charge

Then,

$$R = L(1-s+y) \quad (1)$$

$$y = M[(1-L)(1-s+y)+s+z] \quad (2)$$

$$z = N[(1-M)[(1-L)(1-s+y)+s+z]+a] \quad (3)$$

Solving (2) and (3) simultaneously, the following value for "y" is obtained,

$$y = \frac{M(1-L+Ls+Na)}{1-N+MN-M+LM} \quad (4)$$

Solving (4) and (1) simultaneously, the following value for "R" is obtained,

$$R = L\left[1-s+\frac{M(1-L+Ls+Na}{1-N+MN-M+LM}\right] \quad (5)$$

Now if it is assumed that the charge of fat is 90% saponified on the first change, then the fraction "s" representing the glycerol bound in the unsaponified fat is 0.1 and (5) becomes,

$$R = L\left[0.9+\frac{M(1-0.9L+Na)}{1-N+MN-M+LM}\right] \quad (6)$$

Now if it is assumed that on the fitting change the free glycerol is divided between the niger soap and the neat soap layers in the ratio of one to two respectively, then since the glycerol in the niger is represented by "a," the glycerol in the neat soap can be represented by "2a."

It then follows that

$$R = 1-2a$$

or

$$a = \frac{1-R}{2} \quad (7)$$

where "R" is the fraction recovered of the available glycerol, "2a" is the glycerol lost in the neat soap, and "1" is the available glycerol in the fat charge. Solving (6) and (7) simultaneously, the following value for "R" is obtained,

$$R = 2L\left[\frac{0.9-0.9N+1.4MN+0.1M}{2-2N+2MN-2M+2LM+LMN}\right] \quad (8)$$

Multiplying both sides of equation by 100,

$$\% \text{ Recovery} = 200L\left[\frac{0.9-0.9N+1.4MN+0.1M}{2-2N+2MN-2M+2LM+LMN}\right] \quad (9)$$

which is the recovery formula for the full countercurrent wash system.

LITERATURE CITED

(1) Ferguson, R. H., Oil and Soap *14*, 115-8.
(2) Govan, Wm. J., Jr., Oil and Soap *21*, 271-5.
(3) Webb, E. T., Soap and Glycerine Manufacture, Davis Bros., London, 1927.
(4) Wigner, J. H., Soap Manufacture, Chemical Publishing Company, 1940.
(5) Wurster, O. H. Oil and Soap *18*, 246-53, 283-6.

Report of the Gossypol Committee

The Gossypol Committee of the American Oil Chemists' Society, since its original appointment in April, 1945, has been engaged in a comprehensive program involving the investigation of the completeness, accuracy, and specificity of the various published methods for the determination of gossypol in cottonseed and cottonseed products.

The first phase of this program, namely, investigation of methods for the determination of gossypol in unprocessed cottonseed, has been under way for some time. The methods listed below are being applied to the determination of gossypol in samples of two lots of pure-bred cottonseed furnished by Dr. J. Winston Neely of the U. S. Cotton Field Station at Stoneville, Mississippi. The methods being investigated cover those pertaining to the extraction of gossypol and subsequent estimation of the content of gossypol in the extracts. The methods are as follows:

Methods for the Extraction of Gossypol from Cottonseed

1. *Exhaustive extraction for 24-72 hours:* Extract in Soxhlet type extractor with diethyl ether (peroxide-free). Schwartze, E. W. and Alsberg, C. L., J. Agr. Res. *25*, 289-295 (1923).
2. *Exhaustive extraction* in Soxhlet type extractor with diethyl ether (peroxide-free) containing 2.3-2.5% ethyl alcohol (by weight) and 1-1.2% water, and having a density of 0.724-0.726 g./cc. at 15.6°C.; water added to mixture in receiving flask (5 cc./350 cc.) [Smith, F. H., Ind. Eng. Chem. Anal. Ed., *5*, 29-33 (1933); F. H. Smith, private communication.]
3. *Exhaustive extraction* in Butt type extractor using same solvent mixture as in (2). Lyman, C. M., Holland, B. R., and Hale, F., Ind. Eng. Chem., Anal. Ed., *15*, 489-491 (1943).
4. *Equilibration:* Equilibrate finely ground seed in chloroform at 37-38°F. according to the method described by Boatner, Caravella, and Kyame, Ind. Eng. Chem., Anal. Ed., *16*, 566-73 (1944).
5. *Equilibration:* Same as (4) using diethyl ether as solvent. Same reference as (4).
6. *Equilibration:* Same as (4) using chloroform at room temperature with agitation according to method of Procter and Gamble, unpublished.

7. *Equilibration:* Equilibrate finely ground seed with 30% aqueous alcohol (by weight) for ten minutes; 72% (by weight) aqueous alcohol added (70 ml./30 ml.) according to method of Boatner, Hall, and Rollins, Bot. Gaz. (in press).
8. *Blending:* Blend cottonseed meats 5 minutes in a Waring Blendor with a mixture of 20 ml. of 30 per cent aqueous alcohol (by weight) 55 ml. of 72 per cent aqueous alcohol (by weight) and 15 ml. of diethyl ether, according to the method of Smith, F. H., Ind. Eng. Chem., Anal. Ed., *18*, 43-45 (1946).

Methods for the Estimation of Gossypol in Cottonseed Extracts

Gravimetric:

1. As dianilino-gossypol by addition of aniline to a Skellysolve F solution of an ether extract of cottonseed, according to method of Schwartze and Alsberg, J. Agr. Res., *25*, 289-95 (1923).
2. As dianilino-gossypol by addition of aniline and pyridine to Skellysolve F solution of ether extract of cottonseed according to method of Royce and Kibler, Oil & Soap *11*, 116, 118, 119 (1934).
3. As dianilino-gossypol by addition of aniline and ethylene glycol to Skellysolve F solution of ether extract of cottonseed according to method of Smith, Ind. Eng. Chem., Anal. Ed., *9*, 517-8 (1937).

Spectrophotometric:

4. As dianilino-gossypol in n-butyl alcohol solution of ether extract according to method of Lyman, Holland, and Hale, Ind. Eng. Chem., Anal. Ed., *15*, 489-91 (1943).
5. As dianilino-gossypol in aqueous alcohol-ether solution of aqueous alcohol-ether extract of cottonseed according to method of Smith, Ind. Eng. Chem., Anal. Ed., *18*, 43-45 (1946).
6. As antimony trichloride reaction product of chloroform solution of chloroform or ether extract of cottonseed. N. B. Omit treatment of extract with concentrated hydrochloric acid according to method of Boatner, Caravella, and Kyame, Ind. Eng. Chem., Anal. Ed., *16*, 566-73 (1944).

In addition to the above methods, procedures have been devised which permit application of all of the methods for the determination of gossypol to aliquots of the same extract. Thus, the completeness of both extraction and estimation methods can be determined independently of each other.

J. T. R. Andrews — Allen Smith
O. M. Lyman — F. H. Smith
H. D. Royce — Charlotte H. Boatner, chairman

Abstracts

Oils and Fats

Edited by M. M. PISKUR and SARAH HICKS

Fat formation in F. lycoperseci. R. F. Witter and E. Stotz (Cornell Univ., Geneva, N. Y.). *Arch. Biochem. 9,* 331-9 (1946). A micro titrimetric method for the determination of the total fatty acids in the mycelium has been developed. The synthesis of fat from glucose by *F. lycoperseci* in nonnitrogen-containing solutions has been studied in shaken and stationary cultures which were buffered at different pH values. The greatest synthesis of fat from carbohydrate was observed at pH 7-8. Since there was little or no growth of the mycelium (as estimated by the change in the level of Kjeldahl N) with the formation of large amounts of fat in these high-glucose solutions, the processes of growth and of fatty acid formation have been separated.

Observations on solubilities and other properties of several antioxidants in fats. W. O. Lundberg and H. O. Halvorson (Hormel Inst., Austin, Minn.). *Proc. Inst. Food Tech. 1945,* 115-26. Analytical procedures have been devised for the determination of various phenolic antioxidants in fats. The methods may be applied in various types of research involving antioxidants, and in control analyses in connection with the commercial introductions of antioxidants into fats. Detailed descriptions have been given of one of the methods using a modified Emmerie and Engel iron-bipyridine reagent and of its use in a study of the solubilities of hydroquinone, NDGA, propyl gallate, and gallic acid in cottonseed oil and lard. The results indicate that all 4 of these antioxidants, including gallic acid, have solubilities that are greater than the concentration ordinarily required to stabilize fats. It was found that NDGA, under the conditions of the active oxygen test, is more effective than any of the other approved antioxidants in stabilizing lard. It was also found that slight colors developed when lards containing the more effective antioxidants were exposed to air for long periods of time at 98°. Color changes were greatest for NDGA and gallic acid which, however, were also exposed for the longest periods of time. Samples of lard containing .01% NDGA were not appreciably oxidized and developed almost no changes in color when stored at room temperatures for a period of 19 months and either exposed to diffuse daylight or kept in complete darkness.

Factors and processes influencing the keeping quality of bacon. D. A. Greenwood, J. E. Striter, and H. R. Kraybill (Am. Meat Inst., Chicago). *Proc. Inst. Food Tech. 1945,* 58-71. The development of rancidity measured organoleptically or by the peroxide values appeared to be related to the nitrite content of the bacon. This is evident from results obtained at the low storage temperatures —17.8 to —15°, where microbes were present in only relatively small numbers. High free fatty acid values appear to be correlated with high microbial counts, particularly of molds and yeasts. Keeping time and quality of bacon can be improved by the addition of small quantities of moldicides and antioxidants which help to control growth of microbes and retard the oxidation of the bacon by atmospheric O_2. Of the moldicides, a sealed carton containing CO_2 was most effective. Ca propionate prevented a deterioration of the bacon, but only in concentrations which made the product inedible. A number of antioxidants retarded development of peroxides but not of free fatty acids. Further studies on the addition of the moldicides and antioxidants to bacon should be conducted.

The surface tension of slightly soluble fatty acids. D. G. Douglas and C. A. MacKay (Univ. Saskatchewan, Saskatoon). *Can. J. Res. 24A,* 8-14 (1946). Surface tension measurements have been made on normal heptylic, pelargonic, capric, and lauric acids above