COMPARATIVE RESULTS IN THE ANALYSIS OF FATS.

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Having had occasion to employ extensively the modification of the Reichert process proposed by Dr. E. Waller (*J. Am. Chem. Soc.*, 8, 155), it has occurred to the writer that some comparative results with the Hehner or wash process would be of sufficient interest to warrant publication.

The modification, or rather extension of the Reichert process is conducted as follows: The Reichert process is strictly followed out; two and five-tenths grammes of fat are saponified with one gramme of caustic potash, and fifty c. c. of seventy per cent. alcohol. The alcohol, after the saponification is complete, is entirely driven off, the last portions being removed by a current of air and the resulting soap is dissolved with the aid of heat, in fifty c.c. of water, and decomposed with twenty c.c. of dilute sulphuric acid (1:10). The flask is now attached to a condenser, preferably of the well known upright glass worm shape furnished with a bulb tube to prevent mechanical carrying over of the acid, and exactly fifty c.c. are distilled off and titrated with $\frac{N}{10}$ NaOH. The Reichert figure is thus obtained. and a certain portion of the volatile fatty acid has been removed. Fifty c.c. of water are added to the contents of the flask, the distillation is repeated and the distillate titrated, and this same course is continued until a practically neutral distillate of 50 c.c. is obtained, that is, one requiring one-tenth of one c.c. of $\frac{N}{10}$ NaOH, or less, for neutralization. The total amount of acidity of all the distillates is now calculated as butyric acid, and the total per cent. of volatile fatty acid is thus obtained.

The insoluble acids now remain in the flask and the bulb tube or adhere to the sides of the condenser or filter used to filter the

distillate. The portion in the bulb tube and condenser is rinsed into a small flask with a little hot alcohol, and that in the flask is allowed to become solid. The liquid underneath, containing sulphuric acid, potassium sulphate and glycerine, is poured off through the filter that received the original distillate. The fatty acids are then treated with hot water several times, allowing them to cool into a cake before pouring the wash water through the filter. When the wash water shows no reaction for sulphuric acid the washing is complete. Three washings of about 100 c. c. each usually suffice for this purpose. The rinsings of the condenser are now added to the insoluble fatty acids, the filter is exhausted with hot alcohol to remove adhering fatty acid, the alcohol is expelled and the contents of the flask are dried to constant or slightly increasing weight at 105°C. The per cent. of insoluble fatty acids can then be calculated.

Bumping during distillation can be avoided by using spirals of coarse platinum wire ; these can be weighed with the flask, and require no further attention.

A blank test of the reagents used should also be made and any acidity yielded by them in the distillate allowed for.

The method conducted as above furnishes :

(1.) The Reichert figure.

(2.) The soluble fatty acids.

(3.) The insoluble fatty acids.

The advantages claimed for this method are as follows :

(1.) A combination of the two most valuable and reliable methods, the Reichert and the elaborated Hehner into one.

(2). Greater ease and rapidity of manipulation than the Dupré method.

(3). Avoidance of loss of insoluble fatty acids due to transfer of the fatty acids from the flask in which the fat was originally weighed. The filter used is a small one and can easily be exhausted with hot alcohol.

(4.) Necessity of only one standard solution instead of four, as in the Dupré process. The $\frac{N}{10}$ Na OH is a very permanent solution and the use of alcoholic K OH which is subject to daily and even hourly change is avoided.

(5.) Accuracy of results. This is shown by the following figures:

BUTTER.

	Wash Process.		Waller's Process.	
	Per Cent. of Soluble Acids.	Per Cent. of Insoluble Acids.	Per Cent. of Soluble Acids.	Per Cent. of Insoluble Acids.
Jersey Butter	6.37	87.67	6.30	87.54
Rancid Butter	6.53	88.48	6.49	88.56
Dairy Butter, November	5.42	87.71	5.61	87.74
Holstein Butter	5.11	89.00	5.28	88.96
Native Butter	5.76	87.09	5.80	87.10
Devon Butter	6.86	87.79	6.86	87.76
OLEOMARGARINE.				
No. 1124	0.16	95.64	0.16	95.50
" 135	0.27	95.68	0.28	95.40
" 492	0.69	94.96	0.67	94.92
" 137	0.18	95.98	0.14	95.94
" 999	0.36	95.12	0.28	95.14
" 686	0.20	96.02	0.23	96.00
" 493	1.68	93.52	1.51	93.78
OILS.				
Olive Oil	0.34	94.82	0.28	94.58
Mustardseed Oil	.....	95.66	.....	95.61
Porpoise Jaw Oil	16.98	71.93	16.70	71.98
Cocoanut Oil	7.00	80.87	4.92	83.12

The results above given all show a satisfactory agreement with one exception, and the two processes may be considered to give practically identical results. The exception in this case is cocoanut oil. It will be noticed that the sum of the fatty acids by both processes is practically the same, but that more soluble acid is extracted by the wash process than by distillation. The results

obtained by both of the processes on this oil were far from satisfactory. In the wash process 2.495 grammes of fat were used and twenty-five washes of the fatty acids were made, each consisting of 100 c. c. of hot and 25 c. c. of cold water; the last washing required three-tenths of one c. c. of $\frac{N}{10}$ NaOH for neutralization and the acidity of each successive wash varied irregularly. By the distillation process the condenser became almost clogged with the fatty acid that volatilized and condensed on its walls. This, of course, was reckoned as insoluble fatty acid. Owing to the fact that the washings in the wash process are filtered hot, while the distillate in the distillation process is filtered cold, the soluble acids in the first, in the case of an oil like cocoanut that contains a large proportion of fatty acids soluble with difficulty in water, are higher than in the latter process. In the analysis of butter and oleomargarine the writer has found the distillation process of great service and in every way reliable.

The results above given were all obtained by the writer in the laboratory of Dr. E. Waller, New York.