THE ACTION OF ALCOHOL ON BUTTER FAT.

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IN order to test artificial butter for added butyrates it has been recommended that the suspected sample be treated with alcohol, which will dissolve any artificial tributyrate. If the undissolved fat then be tested by Reichert's method, we shall find the per cent. of volatile fat acids much less than in the original fat, in case any artificially prepared butyrates have been used.

If this plan of examining suspected butters is ever to be called into practical use, it is, in my opinion, highly desirable, if not absolutely necessary, that we have some definite knowledge of the action of alcohol upon genuine butter fat, under certain fixed conditions, such as could easily be adopted when examining suspected samples.

The following experiments were made for the purpose of determining what changes, if any, were produced in butter by treating it with ethyl alcohol. The alcohol used gave a specific gravity corresponding to 90 per cent. C_2H_6O . The amount used was 10 c.c. alcohol to each gramme of butter fat.

C.c. $\frac{N}{10}$ KHO required for distillate of 50 c.c.
from 2½ grms.
(REICHERT'S METHOD.)

Sample.	Fat dissolved by 10 c.c.	Temperature.	Butter fat.	Dissolved fat.	Undissolved fat.
1.	0.1083	788F.	13 c.c.	24 c.c.	
2.	0.1086	788F.		$25\frac{3}{10}$ c.c.	$9\frac{1}{2}$ c.c.
3.	0.130	768F.	{ 11 c.c. 10½ c.c.	$19\frac{1}{2}$ c.c.	$9\frac{2}{10}$ c.c.
4.	0.120	758F.	$15\frac{7}{10}$ c.c.	$27\frac{7}{10}$ c.c.	$13\frac{1}{10}$ c.c.
5.	0.126		$12\frac{8}{10}$ c.c.	$28\frac{4}{10}$ c.c.	{ $12\frac{3}{10}$ c.c. $12\frac{4}{10}$ c.c.

Sample No. 4 giving in one case only $10\frac{1}{2}$ c.c., and 11 c.c. $\frac{N}{10}$ KHO in another, to neutralise the distillate from 2½ grms. of fat was more than 10 months old. In a third test of this same butter known to be genuine $10\frac{1}{2}$ c.c. $\frac{N}{10}$ KHO were required. This butter was at the time in a state of good preservation, and was perfectly palatable.

Hehner and Angell, in their work on butter analysis, found that the insoluble fat acids of butter increased somewhat with age. This being the case we might expect some decrease in the per cent. of soluble fatty acids, and this result, therefore, seems to be in accord with the report of Hehner and Angell.

Three other samples of butter tested in a similar way, but no attention paid to the condition of temperature, gave results as follows :—

PER CENT. OF VOLATILE FAT ACIDS IN			
Sample.	Butter fat.	Undissolved fat.	Dissolved fat.
1.	$6\frac{3}{10}$ per cent.	$5\frac{23}{100}$ per cent.	$10\frac{15}{100}$ per cent.
2.	$5\frac{96}{100}$ „	$3\frac{1}{10}$ „	$14\frac{43}{100}$ „
3.	$5\frac{39}{100}$ „	$2\frac{71}{100}$ „	$11\frac{87}{100}$ „

The per-cent. of volatile fat acids in the above table was determined in each case by the process of repeated distillations and calculated as butyric acid.

Experiments made with wood alcohol show similar results. I here give results of two such experiments, the proportion of alcohol to fat being 10 c.c. to 1 gram.

C.c. $\frac{N}{10}$ KHO required to neutralise 50 c.c. distillate from $2\frac{1}{2}$ grms.					
Sample.	Fat dissolved by 10 c.c.	Temp.	Butter fat.	Undissolved fat.	Dissolved fat.
1.	225	75°F.	$15\frac{6}{10}$	$9\frac{6}{10}$	$23\frac{1}{3}$
2.	218	75°F.	$10\frac{1}{2}$	$1\frac{24}{100}$	$22\frac{9}{100}$

The second sample of butter was the same as mentioned above, and was ten months old.

From the above work it is very evident that the portion of fat dissolved by methyl or ethyl alcohol is rich in volatile fat acids. We conclude, therefore, that while the glycerides of the volatile fat acids are present in butter in such a condition as not to be readily dissolved by alcohol, yet a part of them yields to the solvent action of this reagent more readily than some of the other fats of the butter. This excess of volatile fat acids in the fat dissolved by alcohol is not due simply to the solvent action of alcohol upon any free fat acid which may be present, as my method of experimenting eliminated this possibility.

If one suspects a butter of being adulterated with an artificial butyrate, and attempts to dissolve such an adulterant by the use of alcohol, it seems necessary to use an alcohol of known strength and to have a known quantitative relation between the alcohol and butter fat employed. If the fat undissolved by alcohol be then examined he must expect to find the quantity of volatile fat acids diminished somewhat even in genuine butter.

Using the method I have adopted I should judge that the undissolved fat of a genuine butter ought to require 9 c.c. of $\frac{N}{10}$ KHO to neutralise the usual distillate from $2\frac{1}{2}$ grammes. If less than nine are required there would be reason to suspect adulteration.

I am inclined to think that more information would be gained by applying Reichert's method to the fat undissolved by alcohol than by applying it to the original fat if we adopt 9 c.c. $\frac{N}{10}$ KHO as the amount of alkali required to neutralise the distillate from $2\frac{1}{2}$ grammes of fat strictly following Reichert's method. This would in most cases show at once the adulteration even in case of an added butyrate; when the same method applied to the suspected butter would not detect this.

Hübl's iodine test also shows that the composition of fat dissolved by alcohol differs from the portion undissolved.

In the following tests the fat was dissolved in wood alcohol of specific gravity .817 at 60° F. The proportion of alcohol used was 10 c.c. to one gramme of fat.

Sample.	Fat dissolved by 10 c.c.	Temp.	Iodine No. of fat.	Iodine No. of dissolved fat	Iodine No. of Undissolved fat.
1.	·225 grm.	75° F.	37	$33\frac{7}{10}$	$38\frac{3}{10}$
2.				$34\frac{6}{10}$	$37\frac{1}{2}$
3.	·218 grm.		$45\frac{3}{10}$	$43\frac{1}{10}$	$45\frac{8}{10}$

Below are two determinations of the iodine numbers when ethyl alcohol 90 per cent. C_2H_6O was used to dissolve the fat.

Sample	Fat dissolved by 10 c.c.	Temp.	Iodine No. of fat.	Iodine No. of dissolved fat.	Iodine No. of Undissolved fat.
1.	·126 grm.		$40\frac{4}{10}$	$37\frac{1}{10}$	$42\frac{2}{10}$
2.	·1197 „	82° F.	$41\frac{7}{10}$	$36\frac{8}{10}$	$42\frac{2}{10}$

The fat dissolved by alcohol has a very low melting point, remaining liquid at all ordinary temperatures, while the undissolved portion has a melting point higher than pure butter fat. In one case the undissolved portion had a melting point of 106° F.

An attempt was made to determine the character of the fat acid condensed in condenser during distillation with the following results :—

The fat acid collected in condenser was dissolved in neutral alcohol, and titrated with $\frac{N}{10}$ baric hydrate; this formed a heavy white precipitate.

Weight of Ba salt thus formed = 0·1325 grm.

Weight of $BaSO_4$ produced from this salt = 0·063 grm.

Weight of $BaSO_4$ which would correspond to 0·1325 grm. of $Ba(C_{10}H_{19}O_2)_2$ = 0·0644.

The melting point of the fat acid collected in condenser was twice determined, and in one case was found to be 80° F., and in the second case 86° F. The last melting point corresponds to that of capric acid. From the above results I judge that the fat acid collected in condenser is composed mostly of capric acid.

Before concluding this article I wish to say that in my opinion the standard of $12\frac{1}{2}$ c.c. $\frac{N}{10}$ KHO as frequently adopted for Reichert's method will need some modification. While fresh butter will give results as high as this standard, or exceeding it, I believe that in case of butters that have been kept for some time we may obtain results short of this. At least this has been my experience with butter made at my home in the fall, and kept over winter, although the butter was still very palatable.