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CONTENTS:

INFLUENCE OF FOOD, ANIMAL IDIOSYNCRASY, AND BREED ON THE COMPOSITION OF BUTTER.[1]

ONE of the fundamental principles of dairying is regard for the influence which the care of the animal, supervision of the milking, separation of the cream, ripening of the cream, churning and washing, have on the quality of butter for table use. These processes also, together with the method of packing, have a notable influence upon the preservation of the butter in a sweet state. The discussion of the above problems, however, is a thing for the practical dairyman rather than the chemist. The chemical composition of butter-fat, as influenced by the character of food received by the animal, the race of the animal, and the peculiarities of the animal, has hitherto been little studied from a chemical point of view. To the latter subject I propose to devote the following paper.

Late in February this year, I received a letter from Professor H. H. Harrington, chemist of the Experimental Station of Texas, accompanied by two samples of butter, which he asked me to examine. The following extract from Professor Harrington's letter will indicate the motive which led him to send the samples: —

"Some work in our laboratory indicates that volatile acids from the cottonseed butter are much lower than has been generally supposed. I send two samples of butter, — one from cottonseed feed, and the other from feed containing no cottonseed. If you can do me the favor of analyzing this butter, I shall send more samples from the same cows on the same feed. We hope in the near future to follow up these analyses with complete analyses of butter from different feeds, feeding two cows on cottonseed, and then changing them to other feed."

The samples sent by Mr. Harrington were small, and a complete analysis could not be made; but the results obtained are of such interest that I will communicate them at the present time, and call attention to the peculiarities noticed.

	Butter from Cottonseed.	Butter from Other Feed.
Volatile acids, No. cc N—10 BaO_2H_2 for 5 grams........	21.00	28.50
Percentage of iodine absorbed	33 40	31.89
Melting-point.......	45° C.	34°.2 C.
Reduction of silver by Bechi	distinct	none

The most remarkable points connected with the analyses are as follows: 1. The low percentage of volatile acids in butter from cottonseed; 2. The phenomenally high melting-point of the butter from cottonseed; 3. The persistence of the reducing agent of the butter from cottonseed, as indicated by its action upon nitrate of silver.

The melting-point of the butter is higher than that of pure lard. The particular point to be noticed in this matter is, that in butter designed for consumption in Southern countries, or produced in Southern countries, the mixture of cottonseed with the feed of cows will tend to raise the melting-point of the butter, and render it more suitable for consumption in hot climates.

The persistence of the reducing agent is also a matter of interest. It has passed, in the samples examined, through the digestive organism of the cow, and has re-appeared in the butter with almost undiminished activity. The selective action of the digestive organs on the different glycerides contained in the food of the animal is also a matter of importance. It would be expected *a priori* that the butter from a cow fed largely on cottonseed-oil would contain more oleine and have a lower melting-point than if ordinary food were used. On the contrary, it is seen that either the more solid glycerides have been absorbed during the process of digestion, or that the oleine has undergone some distinct change in the digestive organism by which it has assimilated the qualities of the other glycerides.

From an analytical point of view, the results are of great importance, since they show that a butter derived from a cow fed on cottonseed-meal or one excreting a fat of unusual quality might be condemned as adulterated when judged alone by the amount of volatile acids present. Since cottonseed-meal is destined to be a cattle-food of great importance, especially in the southern part of the United States, this is a fact of the greatest interest to analysts.

The observation of Mayer, soon to be mentioned, that the specific gravity of butter-fat varies with its content of volatile acids, I have also verified in some cases by the determination of the specific gravity of samples of butter-fat taken from the milk of the same cows kept on the same food, but taken the following day after the samples mentioned. The specific gravity for the cotton-meal fed sample was .8929 at 99°; that for the ordinary fed sample, .8991 at 99°.

Professor Mayer's experiments were made on a single cow of a North Holland breed. From time to time during the progress of the experiments the original food was used, in order to see what effect the period of lactation would produce. The cow was fed for twelve days on each separate ration before the samples were taken. After two days more, another set of samples was taken, and then the food changed for a new experiment.

In the butter-fat the melting and solidifying points were taken, and the volatile acids determined according to the method of Reichert. The specific gravity was also determined by the Westphal method at 100°.

The rations of the cow were composed of the following ma-

[1] Abstract of a paper by H. W. Wiley, read before the Society for the Promotion of Agricultural Science at its annual meeting held in Toronto, Canada, Aug. 26, 27, 1889.

terials: ration No. 1, 15 kilograms of meadow-hay and 2 kilograms of linseed cake; No. 2, siloed grass *ad libitum*, and 2 kilograms of linseed cake; No. 3, 20 kilograms of beets, 8 kilograms of hay, and 2 kilograms of linseed cake; No. 4, pasture-grass *ad libitum*; No. 5, chopped clover with 14 per cent of other grasses *ad libitum*.

The highest melting-point observed, viz., 40.5, was from ration No. 1; and the lowest, viz., 32.5, from ration No. 5. The highest volatile acids were produced by No. 3; the lowest volatile acids were observed with ration No. 2.

The results of my analyses were obtained on the first samples of butter sent by Mr. Harrington, and were published in *Agricultural Science* for April 1, 1889, pp. 80 *et seq*. Not fully satisfied with the result of a single determination, I asked Professor Harrington to send me other samples of butter, which he did on two subsequent occasions. The analyses of the two last sets of samples sent did not fully bear out the results obtained in the first set.

The importance of a more careful study of this subject led me to institute some feeding experiments of my own, in order to unravel, if possible, the mysteries of the preceding analyses. I accordingly obtained authority from the secretary of agriculture to arrange for certain feeding experiments with Professor Alvord of the Maryland Agricultural Experiment Station. Three cows were selected for these experiments, described by Professor Alvord as follows: No. 1, full-bred Jersey; No. 2, full-bred Ayrshire; No. 3, cross-bred Jersey and Ayrshire.

These cows were kept on ordinary pasturage for ten days, and then the milk from each of the cows for three days was taken for the experiments. All the milk was subjected to the same conditions. It was set in earthen bowls in a refrigerator at 45° to 50° F., and skimmed after twelve hours. The cream was mixed and kept at 55° to 60° until the fourth day after the beginning of the milkings. The cream was then ripened in a room at 60° F. temperature for twenty-four hours. After cooling to 62° F., the cream was churned; the temperature rising from 62° F. at the beginning of the churning, to 65° at its close. The time required for each churning was twenty minutes. The three days on which the milk was saved were damp, hot days, very unfavorable for making good butter. In all cases the butter was thoroughly washed in cool well-water, made into rolls, and put in glass jars. One-half of each sample of the first lot was salted at the rate of two-thirds of an ounce of salt to one pound of butter.

After the conclusion of the first set of experiments, the cows were gradually changed to a ration of cottonseed-meal, using the commercial variety, such as is used for fertilizing purposes, as no unextracted cottonseed-meal could be obtained at this season of the year. The ration of cottonseed-meal was gradually increased, the cows finally being given all they would eat of it. The following are the facts as to the second lots. The feeding of cottonseed-meal was commenced on the 25th of July, giving but one pound at a feed at first, but constantly increasing the quantity.

During this trial the cows were turned into a small lot with very short pasturage, for exercise and access to running water. They were fed only the cottonseed-meal, and consumed the quantity stated. At the close of the trial, the Jersey and cross-bred cows were beginning to refuse the meal. The Ayrshire continued to eat all offered, and probably could have been fed twelve pounds a day; but I was afraid to give her over eleven pounds a day, and did that only twice. She later kept on at eight and ten pounds per day, while the others fell to one pound and two pounds.

In general, the data obtained corroborate the results of the first study of the samples sent by Professor Harrington. The melting-points of the butters from cows fed on cottonseed meal are markedly higher than from the other samples. There is also a markedly diminished content of volatile acids in these butters, and a lower iodine absorption power. The latter character is unlike the Harrington sample. Another characteristic phenomenon noticed in the first samples of butter is also here repeated; viz., the persistence of the reducing agent which is present in cottonseed-oil in the butter derived from animals fed thereon. The physiological importance of this phenomenon will be mentioned in another place. The most curious results, however, of these experiments is found in the increase in the butter of the glycerides having a high melting-point; in other words, the glycerides of the palmitic and stearic series. While further experiment may be necessary to show that there is a uniform diminution of volatile acids in butters from cows fed on cottonseed-meal, the fact is now most clearly established that the melting-point of such butters is uniformly higher. In regard to the absorption of iodine by the butters from cottonseed-fed cows, the results obtained are somewhat at variance with those secured by Ladd, who states that butter from cows fed on linseed-meal contained 3.5 per cent more oleine than those samples which were obtained from cows fed on bran. This conclusion of Ladd's, however, may not be the true one, since linseed-oil has an iodine absorption of about 155 per cent, and this high co-efficient may have had some influence upon the butter as regards iodine absorption. It is possible, therefore, that some of the linoleic glyceride, which has so high an iodine-absorbing power, may have found its way into the butter, thus increasing its iodine absorption.

Another important characteristic of the butters examined is seen in their abnormally low content of volatile acids. If we compare the samples from the Maryland station with those from Kansas, we have a very characteristic contrast between abnormal pure butter and normal pure butter. The two samples from Kansas show a percentage of volatile acids which is not unusually met with in samples of pure butter. On the other hand, the samples from the Maryland station show an abnormally low content of volatile acids. This percentage of volatile acids is indeed so low that these butters would be condemned as spurious if we relied upon the volatile acid test alone. It does not seem so strange, in the light of these facts, that Allen should have found abnormal Danish butters which, nevertheless, from their history, were certainly genuine.

In so far as the breed of the animal is concerned in the above experiments, it does not seem to have greatly influenced the composition of the butter. The low content of volatile acids may therefore be attributed either to the pasturage, or to the peculiarity of the animals themselves, or to the period of lactation. It would hardly seem probable, however, that three animals taken at random should have exhibited in almost the same degree the abnormal qualities indicated in the composition of the butters.

The physiological questions which are suggested by the above study are of the utmost consequence. In a paper entitled "Note on the Action of Digestive Fluids on Oil," published in *The Medical News* of July 28, 1888, I called attention to the remarkable influence exerted on a large quantity of oil in the human digestive organs. A pint of oil, presumably sweet-oil, but more likely cotton-oil, was administered to the patient for the relief of an obstruction in the gall-duct. This oil, in passing through the digestive organs, was completely decomposed mostly into fatty acid with some soap, forming an emulsion in the alimentary canal, and, being voided in the form of rounded masses of considerable consistence, was mistaken by the patient for gall-stones. This action of the digestive liquids was entirely unexpected, and seems to show that the commonly accepted notion that the fats are acted upon in the digestive organs by being emulsified, and thus absorbed into the circulatory fluids, is an erroneous one.

It is the common supposition that the facts have for a physiological function the maintenance of the animal heat of the body, and the nutrition and supply of the fatty portions thereof.

The experiments in feeding cows on cottonseed-meal would seem to indicate that the natural glycerides contained in cottonseed-meal do not appear in the butter of the cows fed thereon. If the cottonseed-oil in the food should pass unchanged into the butter, we might, it is true, have a lowering of the volatile acids; but this would be accompanied by a great increase in the iodine absorption and a marked lowering in the melting-point. It is quite certain that the glycerides of butter which yield on saponification volatile acids are not derived from similar glycerides in the food of the animal. It may also be quite true that none of the glycerides in the butter of the cow is derived from the fat of the food of the animal. It is more than likely that the fat of milk is a direct product of digestion, and is formed conjointly from the carbohydrates and the albuminoids in the cow's food. We need not, therefore, be perplexed any longer at the presence of so small a portion of stearine and so large a proportion of the butyric series of the glycerides in the fat of milk.

From the evidence already at hand, I think we would be justified in saying that practically all the fats in milk are products of digestion, and none of them results of simple translation through the digestive organs of fats already present in food. On the other hand, we have undoubted evidence of the translation of other substances directly from the food of the cow to the butter-fat, as is shown in the presence of the aldehyde in cotton-oil, which reduces silver, in the butter of cows fed on these substances. Among other studies on the influence of the food on the composition of butter, I might cite the paper of Ladd, already noted; and also one by C. J. von Lookeren, published in the *Milch Zeitung* (No. 3, 1889, p. 47); and the paper of Mayer, published in *Die Landwirtschaftlichen Versuchs Stationen* (vol. xxxv. p. 261). These studies are of such practical interest, that it is my intention to continue them during the coming year on an extended series of feeding experiments, in which I hope to interest experimenters in different parts of the country.

THE STING OF THE JELLY-FISH.

DR. B. W. RICHARDSON writes on the above subject in the last number of the *Asclepiad*, giving a personal experience of his own. He says, —

"In my case I was caught by the shoulders and chest in the tentacles of a large medusa, and had really for a minute or two a difficulty in freeing myself. The surface of the skin touched by the tentacles began to smart at once, and, by the time I was out of the water and partly dressed, the skin was covered, over the surface attacked, with a bright erythema, accompanied with a sense of extreme heat and irritation. The sensation was much the same as that brought on by the application of a mustard poultice, except that it was not so uniformly diffused, but was rather in the form of wheals in slightly raised lines, with a considerable number of points at which the tingling and heat were most severe. Unfortunately, I had no clinical thermometer by me with which to take the local temperature, but, judging by the touch of the hand, the local temperature was raised at least two or three degrees. The redness and irritation lasted seven hours, and did not absolutely subside until after a night's rest; but, during the time it was on in the acute form, it was soothed considerably by the application of water, rendered alkaline by common washing soda in the proportion of an ounce of the soda to about two quarts of water.

"A friend of the writer suffered far more severely. He was bathing where a number of jelly-fish were present, and got so entangled amongst them, that, as he said, he was 'stung over almost all the surface of his body.' He suffered from an acute erythematous eruption, which lasted over sixteen hours, attended with two degrees of general fever, and followed by malaise that lasted three days.

"A still more important case happened in a very singular manner to another friend and patient. I had gone down to a bathing-place in the summer of 1872, not knowing that my friend was there. I had not been on the spot two hours, when a messenger came to me, asking if I would go at once to Mr. G., the friend in question, because he had been 'stung in the throat by a jelly-fish, and they were afraid he would not live.' On reaching my friend, who had accidentally heard I was near to him, I learned that about two hours before, while he had been floating on his back in the sea, with his mouth open, the tentacles of a jelly-fish swept into his mouth, and stung him severely in the back of the throat. There could be no doubt about the mischief, for the throat over the whole of the pharynx was intensely red, and the surface was rough and raised. With this condition there were considerable heat and irritation, amounting to acute pain, and attended with inability to swallow any thing except fluids cooled with iced water. The idea of extreme danger was present in the mind of the sufferer, and I believe my firm assurance that he would take no harm contributed as much to the recovery that succeeded as the simple alkaline remedies which formed the chief part of the medical treatment. In this case also there was a rise of two degrees of temperature, and during convalescence there was marked depression of both mind and body for a period of two or three days.

"In describing these phenomena," he adds, "I have used the ordinary word 'sting' for the want of one more accurate. Really, I do not know whether it is a sting, like that of a wasp or a nettle, that is inflicted, or whether a secretion, acrid in kind, is thrown upon the surface, and acts directly as an irritant fluid. On the whole, I suspect it is a fluid, or organic acid, which is the cause of the irritation. For the resultant erythema, local alkaline treatment is particularly effective. In the throat case, bicarbonate of soda with *mel boracis* proved very grateful and useful."

MENTAL SCIENCE.

The Energy and Rapidity of Voluntary Movements.[1]

M. FÉRÉ, whose volume upon the relations of sensation and movement, upon the phases of hypnotism and kindred topics, has given him a deserved reputation, has recently investigated the relation between the energy or physical power at the disposal of the individual and the rapidity of his re-actions to simple physical processes. His main thesis is, that great energy and great quickness of movements are concomitant, and vary in the same way under similar circumstances. He has studied this relation among the hysterical and epileptic (as typical instances of abnormal sensori-motor organisms) as well as in normal individuals.

M. Féré had shown that in hysteria the influence of certain emotions, pleasant in their nature, was to increase the maximum power of exertion, as tested by the "squeezing" of a dynamometer, which action he terms "sthenic;" while opposite emotions decrease such power, and are "asthenic."[2] He now studies the variations in the re-action times to an electrical shock under the same influences, and the concomitant variation in dynamometric power. In five subjects re-acting from the forehead and the back of the hand, both on the right side and on the left, the average re-action times were, T .61, M .61, V .42, R .28, and B .27 of a second, when the dynamometer registered respectively, T, 24; M, 24; V, 28; R, 28; and B, 29. Furthermore, the side of the body from which the re-action is quickest (the subjects are affected with partial anæsthesia) also claims the hand with greatest dynamometric force.

If these subjects are put into the somnambulic stage of hypnotism, the effect upon the re-action time may be either to shorten it or lengthen it, or leave it unaltered; but in every case the power of the maximum contraction is affected in the same way. The re-action times are, for T .61, for V .61, for R .35, for B .25, for M .20, of a second; and the strength of squeeze respectively, 24, 25, 30, 36, 40. Under the influence of an "asthenic" or strength-depriving unpleasant emotion, such as fear, B's re-action time increased from the normal of .29 to .44 of a second, and his muscular force decreased from 29 to 20; M's re-action time of .61 becomes .65 of a second, and his dynamometric record of 24 becomes 25. Similar changes for V are from .42 to .51 of a second, and from 28 to 24; for R, from .28 to .45 of a second, and from 28 to 16; for T, from .61 to .62 of a second, and from 24 to 30. We notice the individual variations, but in general the law is maintained. Under the influence of a "sthenic" or strength-giving emotion, the re-action times decreased and the squeeze increases as follows: for B, .13 of a second and 40; for M, .16 of a second and 46; for V, .28 of a second and 37; for R, .14 of a second and 42; for T, .19 of a second and 38. Essentially similar results are shown for two hysterical patients re-acting to sound instead of to touch impressions. M. Féré records the form of the contraction of the hand, and finds, that, when the effort is powerful and the re-action quick, the curve of contraction rises suddenly, while in the opposite case it rises slowly. He notes, too, many other mainly physiological conditions into which we cannot here enter, but all of which go to show that the speed of re-action times depends upon the rate at which the nutritive processes of circulation, etc., proceed. Essentially similar results were obtained in epileptics. In one case the re-action time to a touch impression was .34 of a second; to a sound impression, .28 in the normal condition; one hour after an

[1] Revue Philosophique, No. 7, 1889.

[2] It is interesting to compare this action with the re-enforcement of the patellar-tendon reflex or knee-jerk by similar means. Any impressive sensation will cause an increase in the response to a simple blow below the knee. Both may be regarded as very sensitive and quickly registering indices of the effect of stimuli upon the nervous system, and have the extreme value that the great rarity of such indications gives them (see Lombard, in Vol. I. No. 1. of the American Journal of Psychology).