XXVII.

ADULTERATION OF FOOD AND DRUGS.

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The subject of adulteration in food and drugs, although always of great importance, has become of still greater consequence in these days of ever increasing sharpness of competition in trade. Very fortunate it is that such a large proportion of those prevalent in food affect more our pockets than they do our health, being rather either fraudulent or accidental than deleterious. In the case of drugs or medicines, however, all sophistications must be considered as deleterious or injurious to health.

Among the articles of food much subject to adulteration, that of milk is by far of the greatest importance, for it forms the only or the principal article of food consumed by a large portion of our infant population during those years when they are least able to withstand any tampering with their nourishment. Besides, it is one of the most important articles of food entering into the daily use of almost all other persons. This is an article of which the adulteration is most easy of execution, and which can be carried to a considerable degree without much liability of detection by the ordinary consumer.

The removal of cream and the addition of water are not of consequence simply as diminishing the amount of nutriment contained in any given quantity of milk, but they affect the digestibility of that which remains. The reduction in the amount of the fat or cream present in a skim-milk results in the formation of a tougher and coarser curd, and it is thus more unlike the fine soft curd which forms in the stomach of a child which has fed upon its mother's richer milk. These differ about as much in digestibility as would a skim-milk cheese swallowed in large pieces from a cream cheese which had been finely masticated. Then, too, the water added, having for the most part to be used upon the sly, is not likely to be of as good a quality as it would be if it were added more openly. Even this last, as common good water is never absolutely pure, will, on being added to milk about a dozen hours before it is to be used, and the milk in the meantime being much shaken up by being carted about town, start such a change in a milk as will prevent its keeping sweet so long as it would if water had not been added, although all other circumstances remained the same. Furthermore, it is a well known fact that milk not yet turned, but which is just upon the point of turning, and
which it will immediately do upon being taken into a child's stomach, will create a greater disturbance in digestion than if it had been taken already absolutely turned sour. Thus the common adulterations of this article of food result in a double injury.

How to obtain a good supply of pure milk for a large city is a problem presenting considerable difficulty for its solution. A well framed law, vigorously and impartially enforced by an inspector well backed by public opinion, and who has greater interest in his task than any salary can give, may accomplish it as nearly as practicable, but it requires means proportionate to the great importance of the ends to be attained. The law must grant ample rights of inspection,—that is, or access to and of taking of samples. The activity of inspection must be such as to make the chances of detection almost certain, and the punishment therefor must follow surely and speedily. The most effectual form of punishment thus far devised would seem to be that of publication in the local journals, whereby a greater penalty is inflicted through loss of trade than could well otherwise be imposed. For ease of conviction in cases of adulteration, a fixed minimum limit of variability in salable milk is of the greatest importance. This, in the interest of the public health, should be drawn, not at the poorest milk ever known to have been obtained from a healthy cow, but it should be at the limit of a fairly good whole milk, which, in the state of Massachusetts, is fixed at 13 per cent. of milk solids. Of these, not less than 3 per cent. should be fat. The average milk of common dairies in Massachusetts has been found to contain about 13.75 per cent. of milk solids.

In large cities, such as Boston, where there is a large demand for cream for use in coffee, etc., the topping of milk is the most common form of adulteration. The major part of the milk sold in stores was being thus treated when I first began to take charge of the milk of that city.

The simplest method of inspection of market milk, with some reasonable degree of accuracy, with which I am acquainted, is by taking its specific gravity by a float, and percentage of fat by the optical test of Feser's lactoscope. This requires only about three minutes' time. Whole cow's milk at the temperature of 60° F. will be found to have a specific gravity of 1.029 to 1.033, and to have not less than 3 per cent. of fat by Feser's test. The limits of specific gravity will be raised .001 by a reduction of 10° F. in the temperature. A simply skimmed milk will have its specific gravity raised above these limits, while its fat will be considerably decreased. A simply watered unskimmed milk will have a specific gravity under 1.030, with a fat percentage somewhat under 3. If the specific gravity and the fat are both much under this, it has been skimmed as well as watered. If, however, the specific gravity is about 1.033, or a little over, while the fat is much decreased, but, however, after this milk has been skimmed, the specific gravity is then that of skim-milk, then it is a whole milk mixed with skim-milk. This is the method of examination which I recommend to milk-dealers and con-
sumers, for their own use. The fat test will not vary more than one
fourth per cent. from the true weight in a whole milk, or more than one
half per cent. in a skim-milk.

For chemists in their laboratories, a modification of the Wanklyn
method is what I find is most advantageous. My modification in brief is,
to evaporate the 5 grm. of milk in its flat-bottom platinum capsule in the
free air upon the top of a water bath, completing it in a paraffine oven at
the temperature of 105° C.; to determine the fat by its removal, by thrice
boiling up the total solids in its capsule, while set again upon the copper
oven with separate portions of a light petroleum naphtha, decanting off
the naphtha, and finally washing off the capsule with the naphtha from
a wash-bottle. This material being so cheap it can be used very freely;
and, moreover, it has another advantage over ether, that of not dissolving
out any of the sugar. With the facilities of my laboratory, determining
the sugar by the polariscope, each assistant can make a full analysis of
over twenty samples of milk in eight working hours, so that by exclud-
ing all undoubted good samples of milk, as determined through their
specific gravity and percentage of fat, and analyzing only the others, one
person can examine a large number of samples of milk per day. The
full details of my modification will be found in my report in 1885, to
the city of Boston as milk inspector, and these are of importance if very
great rapidity of execution is demanded.

For any efficient inspection, every dealer in milk of a city ought to
have a sample of his milk examined at the least as often as once a month.

In Boston there are some three thousand dealers, of whom about seven
hundred are on milk-wagon routes. Some thirty-six thousand of eight
and a half quart cans of milk are sold in the city upon an average daily,
that is, to the value of about $5,250,000 a year, at the price of 40 cents
per can.

Massachusetts is, I believe, the only state of our Union which has a
special vinegar act. Ours is a very simple one, which, besides requiring
a vinegar to be really of the kind for which it is sold, also requires that
it shall have an acidity equivalent to the presence of not less than five per
cent. of absolute acetic acid in weight, and that cider vinegar shall have
a solid residue of not less than one and a half per cent. of cider vinegar
solids. This cider vinegar solid in the pure article is so free from soda
as not to give any yellow tinge to the Bunsen gas-lamp flame when it is
ignited in it. The reaction of this ignited residue upon turmeric paper
furnishes the simplest manner of detecting the presence of the slightest
amount of any free mineral acid in the vinegar. If there be any, it can-
not give the brown alkaline stain, and if there be any arsenic present from
a glucose made by sulphuric acid derived from pyrites, as the last spark
glows through the carbonized mass the familiar garlic odor can be easily
perceived. The percentage of acidity can be most easily determined by
taking 6 grms., or in a commercial way 6 c. c. of vinegar, diluting it suf-
niciently with water to make it about white, adding a few drops of an
alcoholic solution of pheno-phthalein, and then running into it from a
burette a normal solution of soda until the pink color of the neutral point is reached. The number of cubic centimeters of soda solution consumed is the percentage of acidity of the vinegar. A pure cider vinegar gives only the slightest perceptible reaction for sulphates by barium, for chlorides by silver, or for lime by oxalate of ammonium. If more than this, it is not a pure article, while it should give a good precipitate for malic acid, with a solution of subacetate of lead.

The examination for adulteration in drugs for the state of Massachusetts is conducted under an excellent statute based upon a draft for an act drawn by the National Board of Trade, after the prize essay of G. W. Wigner, of London. Under this act, according to the rulings of our courts, the last revision of the United States Pharmacopœia is the standard for all the drugs and preparations mentioned therein.

During my first year's work for our state board of health, I examined about three hundred samples of pharmacopœial drugs, and of them I found that about 40 per cent. did not conform to its requirements. The drugs examined were principally such as were of the greatest importance as medicines, such as had been reported in recent pharmaceutical literature as wanting in strength, quality, or purity, and such as contained some costly ingredient, the omission or diminution in the quantity of which would greatly increase the profit of sales, and which, from the difficulties of its detection, would be likely to pass unchallenged.

Naturally, in such a list the numerous preparations of opium and of cinchona bark formed a very important part. Of opium preparations, that of the tincture is probably the most frequently used. Of this tincture I examined one hundred samples. Of these, four only exceeded the maximum allowable strength of 1.60 per cent. morphine, according to the 1880 revision of the United States Pharmacopœia; while 82 fell below the minimum allowed of 1.20 per cent., 43 only fell below about .90 per cent. morphine, which, according to the revision of 1880, was the quantity required by the revision of 1870, and its method of assay. Their average strength was .965 per cent. morphine, the extremes being .336 and 1.87 per cent.

In specific gravity they varied from .921 to .997, with a mean of .953. This preparation is a striking example of the very great need of an enforced uniform standard. There was one sample of this very important and powerful drug very nearly six times as strong as another, to the great danger of the health and even the life of the public, about equally from the danger of either want of action or over-action. In a case of emergency, the too weak sample being the one used, the patient might die for want of the proper action; or, if a patient or physician, having become accustomed to the largely increased size of dose necessary with the weaker preparation, afterward takes or gives the stronger preparation in the same dose, again fatal results may happen from over-action. Thus from either cause the patient may die. There is a much greater apparent than real change in the strength of the laudanum made according to the 1880 revision of the United States Pharmacopœia over that of 1870.
An opium that will give the 12 per cent. morphine required by the 1880 process of assay will just about give the 10 per cent. by the 1870 process, if it be conducted in the most favorable manner; so that the maximum required strength of powdered opium remains the same. In the tincture, however, there has been made the change from the about 9 per cent. opium of the revision of 1870 to the exact 10 per cent. of the revision of 1880; that is, the revision of 1870 is about one tenth weaker in opium than that of 1880.

The proper method of assay of the tincture of opium, under the revision of 1880, is to take 70 grms. of it and evaporate it to dryness at not above 85° C. as directed under powdered opium, and then to proceed exactly as directed for opium itself. The resulting weight in grammes multiplied by two gives the per cent. of morphine strength. This process of assay for opium is part of the required standard, which is that the opium should contain not less than the 12 per cent. by the given method, while the absolute contents are not mentioned at all. The about 50 samples of powdered opium which I examined yielded on an average 13.34 per cent. morphine, even although several of them had evidently by intention been reduced by the addition of milk-sugar down to about the minimum allowable strength of 12 per cent. Only one of them exceeded the maximum of 16 per cent., and none, except the evidently reduced, fell below 12 per cent.

Next most important to the opium preparations, if they do not even excel them, are the preparations from cinchona bark. Of the simple cinchona alkaloid salts which I examined, about 25 per cent. of them contained an excess of the cheaper alkaloids. There was no case of total substitution, however. Of the citrate of iron and quinine, out of 40 samples, 33, or 82.5 per cent., fell below their proper weight of 12 per cent. quinine. One contained even as little as one half of one per cent. The deficiencies were all of quantity rather than of quality of the quinine.

All the ready-made coated quinine pills of the Boston market have been examined. The best method to employ for the assay of quinine pills is to take say ten two-grain pills, dissolve them in a little water in a small capsule, breaking up with the aid of a small glass rod, add excess of caustic lime, and dry thoroughly at 100° C. Remove the dry mass and powder very finely, and transfer to a tube for continuous percolation with strong ether of the United States Pharmacopoeia. Although all alkaloids were practically extracted in six hours, I continued it for forty-eight. Then evaporate the ethereal extract obtained, after transferring to a beaker to dryness at 100° C., and weigh the residue. It is needless to say that in these two transfers the utmost care should be taken that no material be lost, and therefore that the capsule, mortar, and extraction flask be thoroughly rinsed out with ether till no bitterness remains in them. The ratio of the anhydrous alkaloid obtained to what 20 grains of sulphate of quinine, even with the 8 molecules of water allowed by the United States Pharmacopoeia, should have yielded, gives the weight of quinine which the pill may have contained. This alkaloid
should then be submitted to the United States Pharmacopoeia test of quinine for identity and quality. This last is the Kerner's test for the presence of the cheaper cinchona alkaloids. It excludes more than 1 per cent. of quinidine or cinchonidine, or more than a trace of cinchona.

About two hundred samples of powdered pharmacopœial drugs were examined microscopically, and about 20 per cent. were found to contain foreign ingredient, or, rather, appeared so, for it is not common now as formerly that totally foreign substances are introduced, but it is the closely allied and inferior varieties, or damaged samples and trimmings of the very same drug, that are used. Millers now study structural botany, and are becoming as expert as those whose duty it is to expose their improper practices. They have the excuse of the too well known fact, that many druggists require as many pounds of the powdered drug to be returned from the mill as were sent, refusing to allow anything, or the proper amount, for the well known inevitable loss incident to the necessary drying and subsequent powdering of the drug. And they say that in returning as much as was sent no deceit is practised, for every one must know that something must have been added to make up for the loss incident to the powdering. The consuming public, however, are none the less deceived, although the trader may not have been.

The duty of examining food and drugs for adulteration has given rise to a new profession,—that of public analysts or sanitary chemists. It would be very advantageous if they were united here in America into some sort of an association equivalent to the Society of Public Analysts in Great Britain, to which some of us have the privilege of belonging. It is only by uniformity of process that we can obtain results which are justly comparable with each other. It would add greatly to the public estimation of the calling if all the analysts could agree in their results when reporting upon the same article.