OUR MEMPHIS MILK SUPPLY.*

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There is no article of diet the purity of which is of so much importance as that of milk. Other foodstuffs, though subject to adulteration, are rarely given to invalids and never to infants, while it is just they who consume milk almost exclusively, and in whose food supply purity and quality are of first importance. Moreover, milk is an animal secretion, and its quality depends on the health and condition of the animal yielding it. Physicians should acquaint themselves with the quality of milk their patients are using, and with this object in view I made a series of analyses.

The milk supply of large cities necessarily comes from a distance. It requires time to collect and distribute this milk, a circumstance which in itself materially influences its quality. In Memphis most of the milk reaches the consumer by wagon from the dairies in the suburbs. It is collected about twelve to twenty-four hours before it reaches the consumer, and during the time of delivery is exposed to a great extent to the influence of temperature, atmosphere, and dust. Finally, it may be adulterated before it leaves the dairy.

If we wish to examine the kind of milk most consumers get, it is necessary to choose what we may call "commercial milk," i. e., a milk which is essentially a mixture of products of a number of cows, subject to adulteration, exposure, and the influence of time.

I collected twenty-six specimens of this kind in all; they constitute a fair average of our whole supply. It was purchased directly from the dairy wagon during early delivery hours, and at once placed in clean, sterilized glass bottles.

* Reprint from Memphis Journal of the Medical Sciences, June, 1890.

Method of Examination. An analysis of this kind has no value for statistical and comparative purposes unless the process is known. The literature on the subject shows that a great deal of ingenuity has been wasted on the so-called expeditious, simple, and easy methods. On the other hand, when a large number of analyses are made, and with a view to comparative value, some expedition is necessary. In my preliminary experiments I obtained the most constant results by following the plan given below. The preliminary examination, such as appearance, reaction, pioskop, creamometer, and specific gravity, was made rather to test the value of such examinations, and because they require no time and skill for execution.

1. *Appearance;* deceived me very often; a little excess of coloring matter may cause the milk to look very rich.

2. *Reaction;* was naturally always acid, except one which was alkaline.

3. *Pioskop* (pioscope); consists of a black rubber disc with marginal ring; a few drops of milk are placed upon it and covered by a round glass plate having six radial divisions painted various shades of gray, the center being left transparent. The milk will assume one of the shades of gray (or nearly so) painted on margin, and thus its richness may be read off. A reference to table following will show that it requires quite a difference in proportion of fat to show a different degree, hence intermediate grades were designated by a + or — behind grade of pioscope readings. This is one of the best of preliminary examinations.

4. *Creamometer*, is a glass tube about a foot long, of ½ inch caliber, graduated into 100 parts, and closed at one end; this is filled to 100 with milk and allowed to stand in an upright position for 12 hours, when the per cent. of cream may be read off. The objections to this are 1st, in warm weather the

milk will "turn" before separation is complete; 2d, cream is not a definite proportion of fat and casein; 3d, cream rises more slowly in rich milk.

5. *Specific Gravity; per se* reveals absolutely nothing. If a rich milk has a specific gravity of 1.029, skimming it will bring it to about 1.034 (as butter is lighter) and all the intelligent dairyman has to do is to add water to bring it back to 1.029. In table I omitted specific gravity readings; they varied from 1.020 to 1.034. I am surprised to find that some inspectors do nothing but take the specific gravity.

6. *Analysis; total solids* were obtained by evaporating 20 gm. on water bath to constant weight, and result in gms. $\times 5 = \%$; residue is total solids, the difference or loss represents water and gases. *Fat* was extracted with petroleum benzin. *Sugar;* by standardized Fehling's solution, to which potass. ferrocyanide was added, according to Causse;* this increases accuracy wonderfully. *Salts, and casein;* the residue remaining after extraction of fat was ignited in covered crucible, the residue representing the salts (and carbon) or ash. The loss is sugar, casein, albumin, and extractives; the first, having been estimated, is subtracted.

7. *Adulterations.* In looking over a large amount of literature I find that the only adulterant found was water. Insoluble substance would be detected under the microscope, and at bottom of creamometer. Fat could not be mechanically added. Finally, skimming and diluting is the simplest way and answers all purposes. As will be seen in table, the average of total solids did not come up to the standard in the specimens analyzed.

8. *Microscopic Examination.* This is an easy rough means of judging richness, purity, *i. e.*, presence or absence of dirt and insoluble matter. If milk is rich there will be a preponderance of large globules, and vice versa.

* Proc. Am. Phar. Ass., vol. 37, p. 661.

9. *Bacteriological Examination.* As a hygienic procedure it is of more service in examining milk direct from the individual cow than the "commercial" article. In the latter, microbes usually found in the air, and in milk in the stages of change short of curdling, are found. A special examination for tubercle was made, but none found, nor was this likely in "mixed" milk. Bacteriological literature on this subject is very scant. Some exchanges simply mention that milk has been found infectious. Textbooks on bacteriological technology have no special plan to offer. Tubercle cultures are notoriously hard to grow, especially from a fluid full of other microbes. Flügge[1] says: "Occasionally tuberculous animals are the source of infection; but contagion from milk of tuberculous cows seems to take place only where tubercular affection of the milk glands exists." *Per contra*, Bollinger[2] found milk taken from healthy glands of tuberculous cows to be infectious; but when diluted to 1:40—1:100, it no longer affected guinea pigs, and he therefore considers mixed milk from large dairies preferable to that from single animals. Karl Hirschberger (under Bollinger's direction) found milk infectious in 55 per cent. of tuberculous cows, "even in slight cases of localized tuberculosis." It would thus seem that the physiological test would be the best. Adam Gibson[3] traced an epidemic of typhoid fever in a small town in England to a dairy. On examination of the water supplying it, it was found contaminated with decomposing animal matter. Wm. Brown of Carlisle[4] traced a typhoid epidemic to a dairy in which cows were affected with a febrile disorder. Satisfactory evidence of diphtheria and scarlet fever being traced to dairies also exist. Dairy hygiene will no doubt become a subject of vital importance, if such instances multiply.

The following table gives result of my examinations:

1 Die Mikroorganismen, p. 219.
2 Munchener Med. Wochenschrift, 1889, No. 43.
3 Druggists' Circular, March, 1889.
4 Brit. Med. Jour., Aug., 1888.

No. of Specimen	Appearance	Reaction	Milk Tester (Pioskop.)	Creammeter (per cent. Cream)	Constituents in 100.00 Parts by Weight						Microscopical	
					Volatile portion, (water and gases)	Total Solids	Fat (Butter)	Carbohydrate (Milk-Sugar)	Casein, Albumin and extractives	Salts (Ash)	Appearance of Milk	Bacteriological Examination
1	Rich	ac.	Normal	15	88.00	12.00	4.80	3.40	4.15	.65	Very fat	
2	Poor	ac.	Less fat	10	90.70	9.30	3.20	2.45	3.15	.50	Less fat	Streptococci.
3	Fair	ac.	Normal	12	88.25	11.75	3.75	3.55	4.10	.40	Med. fat.	Diplococcus Ros. and others.
4	Rich	ac.	Normal +	16	87.60	12.40	5.15	3.35	3.50	.35	Fat	Unclassified.
5	Fair	alk.	Normal +	13	85.95	14.05	4.65	4.20	4.25	.90	Med. fat	Unclassified.
6	Rich	ac.	Normal +	10	87.35	12.65	3.60	4.10	4.23	.82	Medium	Unclassified
7	Fair	ac.	Normal	10	87.55	12.45	3.15	4.30	4.20	.60	Medium	Unclassified.
8	Ordinary	ac.	Less fat	11	86.60	13.40	4.00	4.40	3.15	.95	Less fat	Unclassified.
9	Fair	ac.	Normal	10	88.15	11.85	3.40	3.85	4.20	.40	Medium	Diplococci and Staphylococci.
10	Fair	ac.	Normal +	10	87 35	12.65	3.70	3.90	4.10	.95	Medium	
11	Rich	ac.	Normal +	13	85.55	14.45	5.20	4.45	4.25	.70	Fat	
12	Fair	v.ac	Less fat	11	86.05	13.95	4.25	4.30	4.55	.90	Medium	Zoogloea.
13	Very rich	ac.	Normal	15	85 85	14.15	5.10	4.07	4.15	.83	Very fat	
14	Rich	ac.	Normal +	16	84.35	15.65	6.05	4.95	4.25	.45	Very fat	
15	Poor	ac.	Less fat —	8	90.25	9.75	2.45	3.30	3.55	.35	Less fat	Dip. Roseus.
16	Ordinary	ac.	Less fat	8.5	88.55	11.45	3.70	3.80	3.55	.40	Less fat	
17	Ordinary	s.ac.	Less fat	11	89.40	10.60	3.10	3.25	3.60	.65	Less fat	Dip. and Staphyl.
18	Ordinary	s.ac.	Poor	8	90.70	9.30	2.55	3.54	2.25	.95	Less fat	Oidium Albic.
19	Fair	ac.	Normal	10.5	89.05	10.95	3.15	4.04	3.02	.72	Less fat	
20	Fair	s.ac.	Normal	13	88.45	11.55	3.55	3.78	3.20	.90	Medium	Staphylococci, Bac. ac. Lactic
21	Fair	s.ac.	Less fat	10	88.40	11.60	3.35	2.80	4.50	.92	Medium	[Diploc.
22	Very rich	ac.	Very rich —	20	85.35	14.65	5.45	4.18	4.05	.95	Very fat	Oidium Albic.
23	Fair	s.ac	Normal	8.5	88.60	11.40	3 25	3.97	3.21	.97	Less fat	Tetrageni.
24	Fair	s.ac.	Normal	7.5	87.35	12.65	2.70	4.15	5.18	.62	Medium	Staphyloc.
25	Rich	ac.	Less fat	11	89.75	10.25	3.07	3.17	3.14	.87	Less fat	Diploc. Roseus, Bac. ac. Lact.
26	Very rich	s.ac.	Normal +	25	88.20	11.80	3.90	2.85	4.48	.67	Very fat	Diplococci.
Highest of each			Very rich —	25	90.70	15.65	6.05	4.95	5.18	.97		
Lowest of each.....			Poor	7.5	84.35	9.30	2.45	2.45	2.25	.35		
Average constituents.						12.16	3.85	3.78	3.84	.70		

The question now comes up: What is the standard of normal milk? Authorities differ, and below I give a table of such as were accessible to me:

Name	Literature	Water	Total Solids	Fat	Other Solids	Sugar	Casein & Alb.	Salts
Foster	Physiology	85.70	14.29	4.30	.....	4.03	5.39	.54
Brubaker	Physiology	89.0	11.0	2.5	.....	4.8	3.5	.2
C. A. Cameron	Chem. News, Feb. 5, 1875..	87.0	13.0	4.0	.....	4.20	4.10	.....
Simon	Manual of Chemistry	86.95	13.05	3.65	.....	4.25	4.40	.75
Lehmann	Phys. Chemistry	87.0	13.0	4.0	.....	4.2	4.1	.7
France	A. J. Lynch, Pr. A. P. A. No. 37	.....	.....	2.70	8.80	.....	.....	.....
England	" "	.....	.....	2.50	9.	.....	.....	.....
New York	" "	.....	.....	3.	9.	.....	.....	.....
Massachus'tts	" "	.....	.....	3.65	9.35	.....	.....	.....
New Jersey	" "	.....	.....	3.	9.	...	.....	... .
Average	.....	.....	12.43	3.36	.....	4.3	4.3	.....
A. J. Lynch	Mean of 8 analyses	.....	.....	3.64	10.13	.....	.....	.....

Lynch analyzed Philadelphia dairy milk, one being from an Alderney cow yielding 5.21 of fat, and 15.60 of other solids. Other unofficial analyses give results similar to those given above. The figures on my table show the average of fat to be rather above that of these figures, and total solids below the average. Thus we see that only 13 out of the 26 came up to the New York standard for total solids, and only 3 below it for fat. No. 26, though containing nearly 4 per cent. fat and 25 per cent. cream, cannot be considered extra good, the other solids being only 8 per cent. and the sp. gr. 1.020.

Dr. T. M. Rotch,[1] in speaking of the value of chemical examination of milk, urges that more analyses be made, and all reliable analyses be published (particularly of mother's milk), in order to enable us to better comprehend the causes of inanition.

Thus, if artificial mother's milk were to be made according to the formula given, results would vary considerably if No. 24 were used in one case, and No. 26 or No. 14 in the other.

1 Keating; Cyclopedia of Diseases of Children, vol. 1, p. 288.

The bacteriological examination shows that, next to getting fresh milk direct from the healthy cow, sterilization, at the expense of digestibility and palatability, is the best protection against infection. Where milk is ordered to be taken direct from the cow, the animal's condition of health should be carefully looked into.

Finally, health authorities should make it their duty to regulate and control the supply of milk, and see that no adulterated or infected article reaches the market.