STUDIES OF INFANT FEEDING. X.

THE DIGESTION AND ABSORPTION OF FATS. I.

CALCIUM IN ITS RELATION TO THE ABSORPTION OF FATTY ACIDS *

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INTRODUCTION

It is a fact well recognized by pediatrists that the digestion and absorption or nonabsorption of fats is probably the source of a greater part of the troubles encountered with bottle fed infants who receive cow's milk in some modification. Frequent examinations of infants' stools to detect the presence of fats and soaps, and great care taken to prevent the continued presence of an excess of soaps in the stools, are common routines in many hospitals.

Many cases of so-called "infantile atrophy" and most cases of "fat intolerance" apparently show abnormalities with respect to fat metabolism and their general condition can be improved by withholding fats to some extent. While such cases have generally been considered to show abnormalities in their metabolism of fats, a study of them soon convinced us that the trouble is one due to a faulty feeding, for any modification of cow's milk which gives a food containing the desired amounts of fat, sugar and protein does not modify or rearrange the inorganic constituents of the milk.

Cow's milk is nature's food for the offspring of the cow, contains inorganic constituents in sufficient amounts to supply the demands of the rapid growth and development of this animal and is especially rich in calcium and phosphoric acid, substances which the young of the cow use to develop rapidly growing bone tissue, but which the infant uses very sparingly. When fed to infants in the proportions found in cow's milk or modified cow's milk these substances are greatly in excess of the amounts required to supply the demands of the infant, and hence are eliminated either in the urine or feces.

In this connection it is a noteworthy fact that notwithstanding the high calcium content of cow's milk the calcium metabolism of bottle fed infants, as measured by the calcium eliminated in the urine, is

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* From the Boston Floating Hospital Laboratories, and the Pediatric Department of Harvard Medical School.

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seldom greater, and often less, than that found in breast-fed infants, most of the calcium being eliminated in the feces as insoluble calcium phosphate and calcium soaps (Table 1). While this mode of eliminating the excess calcium present in cow's milk is in one way a protection to the infant, in that it prevents the calcium from entering the body fluids and tissues in organic combination, subsequently to set up a toxic condition (unpublished work from this laboratory), it may, on the other hand, bring about marked nutritional disturbances.

TABLE 1.—THE ELIMINATION OF CALCIUM, PHOSPHORIC ACID AND FAT WITH BREAST FED AND BOTTLE FED INFANTS

	Breast Fed	Bottle Fed *
Laboratory number	108	70—1
	Grams Per 24 Hours	Grams Per 24 Hours
Calcium oxid in urine	0.069	0.025
Calcium oxid in feces	0.038	1.672
Phosphoric acid [P_2O_5] in urine	0.012	0.342
Phosphoric acid [P_2O_5] in feces	Trace	0.586
Neutral fat and fatty acids in feces	0.093	0.970
Fatty acids as soaps in feces		4.560

* Seven hundred and ninety-five c.c. of a formula containing 2 per cent. fat, 6 per cent. sugar and 1.6 per cent. protein.

The question of calcium metabolism is being given especial attention in the laboratories of this hospital. The examination of many stools from bottle-fed infants in this connection has led us to believe that although neutral fat, free fatty acids and soaps may all be found in these stools, the appearance of neutral fat and fatty acids, except in the case of diarrhea, are wholly secondary, and in most cases do not in any way indicate an impaired digestion or absorption, but rather a faulty feeding which allows an excessive amount of calcium, available for soap formation, to enter the intestines where the conditions are very favorable for the formation of insoluble calcium soaps. These soaps as they are precipitated may carry down with them by occlusion both neutral fat and free fatty acids. If the possibility of the excessive formation of insoluble calcium soaps is removed by the feeding of a decalcified milk, or one with a calcium content about equal to that found in breast milk, it has been found that infants unable to handle any fat in a modified milk can take 3 per cent. of fat in a decalcified or reconstructed milk. This point is clearly demonstrated by the figures given in Table 2.

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TABLE 2.—Showing Decreased Amounts of Fat and Soap in Infants' Stools When Excess Calcium is Removed from Food. Lab. No. 101

Date	Dry Weight, Gm.	Total Fat, Gm.	Neutral Fat and Fatty Acid, Gm.	Fatty Acid as Soaps, Gm.	Calcium Oxid, Gm.	Phosphoric Acid, Gm.	Food	Fat Ingested, Gm.
1916								
March 12. ...	6.94	4.23	0.61	3.62	0.934	0.121	Modified milk with 2 per cent. fat.	24.0
March 13.....	7.44	5.19	1.84	3.35	0.765	0.124		22.2
March 14.....	4.82	2.59	1.01	1.58	0.318	0.054	Decalcified milk with 3 per cent. fat	28.5
March 15.....	3.09	0.66	0.26	0.40	0.012	0.007		36.0
March 16.....	2.47	0.48	0.30	0.18	0.010	0.017		36.0
March 17.....	2.65	0.53	0.19	0.34	0.010	0.035		31.3

I

NATURE OF THE FATTY ACIDS IN THE SOAPS PRESENT IN THE STOOLS FROM BOTTLE-FED INFANTS RECEIVING MODIFIED MILK

In an attempt to determine the nature of the soaps present in infants' stools we have collected a number of the firm, characteristic soap stools usually eliminated by infants receiving modified cow's milk, such infants as are often constipated and frequently show marked distention of the bowels due to the accumulation of gas.

Technic.—One-gram portions of the dry stools were extracted with acidulated ether-alcohol mixture, the extract evaporated to dryness, dissolved in chloroform and neutralized with sodium ethylate. The chloroform was distilled off and the soaps dissolved in water and filtered to remove any neutral fat present. The fatty acids were then precipitated by the addition of hydrochloric acid, dissolved in ether, the ether distilled off and then dried in a desiccator under diminished pressure. The melting points of the fatty acids separated in this manner, together with the total fat elimination per twenty-four hours, are given in Table 3.

TABLE 3.—AMOUNTS OF FAT AND MELTING POINTS OF THE FATTY ACIDS PRESENT AS SOAPS IN THE STOOLS FROM INFANTS RECEIVING MODIFIED COW'S MILK

Laboratory Numbers	Percentages of Fat, Sugar and Protein in Food	Grams Fat Injected per 24 Hrs.	Grams of Fat in Stools Per 24 Hours*	Melting Points of Fatty Acids Separated from Stools
	F. S. P			
70—1	2-6-1.6	15.9	5.53	54 C.
72—1	2-6-1.6	15.9	2.02	53 C.
73—1	2-6-1.75	20.3	5.03	54 C.
74—1	2-6-2	24.3	6.47	55 C.
77—1	2-6-1.6	24.3	5.01	54 C.
79—1	2-6-1.6	28.2	1.47	54 C.
80—1	2-7-2	24.3	2.26	52 C.
81—1	2.4-6-1.9	31.3	3.99	52 C.
101—2	2-8-1.25	22.2	5.19	51 C.
104—1	2-8-1.25	24.0	3.48	52 C.
109—2	2-8-1.25	24.0	4.16	53 C.
115—1	3.2?-1	39.7	5.04	52 C.
116—1	2.5-4.5-2	34.1	4.68	53 C.
117—1	2-6-1.6	20.3	5.37	52 C.
118—2	2-7-1.5	18.2	4.33	52 C.
119—1	3-5-2	34.1	8.40	51 C.
120—2	2.5-5-1.6	26.1	8.19	50 C.
121—2	2.5-5-1.6	26.1	7.21	50 C.
122—2	2.5-5-1.6	22.7	2.64	54 C.
125—2	2-7-1.5	14.2	3.13	53 C.
126—2	2-6-2	25.2	4.67	52 C.
128—2	2.5-6-2.1	30.9	4.19	53 C.
129—1	3.6-3.2	50.1	7.46	53 C.

* Neutral fat, free fatty acids and fatty acids as soaps.

The fatty acids as obtained for the determination of the melting points given in Table 3 were all united, dissolved in ether-alcohol mixture, filtered through animal charcoal and evaporated to dryness, giving 13.5 gm. The product was evidently a mixture of fatty acids for, at 49 C. it was solid; at 50 C. it was partly melted; at 52 C. it completely melted.

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When dissolved in chloroform 0.3 gm. required 10.9 c.c. of tenth-normal sodium ethylate to make neutral to phenolphthalein. The average molecular weight would thus be

$$\frac{0.3}{10.9 \times 10^{-4}} = 275.2$$

The melting points given in Table 3 and the average molecular weight as found in the equation given seem to indicate that the soaps in the stools are soaps of the higher fatty acids found in butterfat, and in order to learn something of the nature of these fatty acids they were dissolved in water by adding sodium hydroxid and then precipitated as lead soaps by the addition of lead acetate, the lead soaps being then filtered, washed with water and dried. The fatty acids were then separated into four fractions in the following manner:

Fraction 1 was obtained by extracting the dried lead soaps with ether to remove the lead oleate. The ethereal solution of lead oleate was then placed in a separatory funnel with some distilled water, a few drops of nitric acid added and the lead nitrate washed out by the addition of several successive portions of water. It was found impossible to remove all the lead in this manner, so the ether was evaporated off, water added and the oleic acid converted to the sodium soap by the addition of a small amount of sodium carbonate, the soap solution thus obtained being centrifugalized and the oleic acid recovered from the clear solution by precipitating with hydrochloric acid, dissolving in ether and drying. We obtained 2.9 gm.

The lead soaps remaining after the extraction of the lead oleate were suspended in water, decomposed by the addition of a few drops of nitric acid and the free fatty acids removed by extracting with ether in a separatory funnel. The ether was distilled off, the acids dissolved in alcohol, filtered through animal charcoal and evaporated to dryness, leaving a mixture of fatty acids having a melting point of 54 C.

This product was found to contain some lead so it was dissolved in water by the addition of sodium carbonate, centrifugalized, and the fatty acids precipitated by adding nitric acid. The fatty acids were washed with several portions of water acidulated with nitric acid, then with pure water and finally dissolved in alcohol and separated into Fractions 2, 3 and 4 by crystallization.

Fraction 2 when examined under the microscope showed pure needle-like clusters of crystallized palmitic acid, and after being washed with cold alcohol and dried gave 4.5 gm. having a melting point of 62 C.

Fraction 3, when examined under the microscope, showed a preponderance of palmitic acid crystals and a few irregularly formed globules. On being dried, this fraction gave 2.2 gm. having a melting point of 56 C.

Fraction 4 was light brown in color, showed a preponderance of palmitic acid crystals and on being dried gave 2.7 gm. having a melting point of 34 C.

About 0.3 gm. of each of the fractions was dissolved in chloroform and titrated with tenth-normal sodium ethylate and the average molecular weights calculated in the manner just given. The results obtained, together with the other data relating to the fatty acid fractions separated from the infant's stools, will be found in Table 4.

We recovered 12.3 gm. of fatty acids in the four fractions. Fraction 1, containing 2.9 gm. of oleic acid, is 23.6 per cent. of the fatty acids recovered. Fractions 2, 3 and 4, containing 9.4 gm. of fatty acids, which are almost pure palmitic acid, represent 76.4 per cent. of the fatty acids recovered.

The data given in Table 4 demonstrate beyond question that a palmitate is the soap present in largest amount in the stools from

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TABLE 4.—SHOWING AMOUNTS, MELTING POINTS AND AVERAGE MOLECULAR WEIGHTS OF FATTY ACID FRACTIONS SEPARATED FROM INFANTS' STOOLS

	Grams	Melting Point, C.	Grams Taken	Sodium Ethylate C.c. N/10	Average Molecular Weight
Total mixed fatty acids	13.5	50-52	0.3000	10.9	275.2
Fraction 1, oleic acid	2.9	13-15	0.3758	13.2	284.7
Fraction 2, palmitic acid	4.5	62	0.3219	12.4	259.6
Fraction 3	2.2	56	0.3625	14.0	258.9
Fraction 4	2.7	34	0.3675	13.0	282.7

Fractions 3 and 4 on being crystallized from alcohol showed a preponderance of palmitic acid crystals.

bottle-fed infants, but in order to demonstrate this more directly we have examined a number of stools from bottle-fed infants according to the following technic.

About 0.5 gm. of moist stool is placed in a small test tube, 3 drops of acetic acid and 5 c.c. of alcohol are added and the whole heated to just boiling. This gives an alcoholic solution of fatty acids which is now centrifugalized to deposit the insoluble matter and the clear liquid decanted on watch glasses and allowed to evaporate spontaneously until a marked crystallization has taken place. One drop of this mixture of liquid and crystals is now placed on a microscope slide and examined under the microscope.

In every case we found an abundance of palmitic acid crystals and could not find crystals of any other nature. It should be added that oleic acid was undoubtedly present, but as this acid is a liquid at ordinary temperatures, it would remain in solution in the last traces of the mother liquid surrounding the palmitic acid crystals.

The next point to be determined was the nature of the base which had combined with the fatty acids to form the soaps. Stools from the type of infant under consideration always show an excess of calcium over that required to form insoluble phosphates with the amounts of inorganic phosphorus present, and it seemed evident from the first that the soaps present were insoluble calcium soaps, and this suspicion was confirmed by the following procedure:

Portions of the stools were placed in Erlenmeyer flasks with 100 c.c. of water and brought to the boiling point, any sodium, potassium or ammonium soaps being thus dissolved in the water. The insoluble material was then filtered off and the fatty acids precipitated from the filtrate by the addition of a drop of hydrochloric acid. In no case was the amount of soap dissolved sufficient to produce more than a slight turbidity when the fatty acids were precipitated by the hydrochloric acid added.

It is therefore seen that the soaps present in these stools were almost wholly insoluble soaps and as calcium is the only insoluble base present in appreciable amount, it must be concluded that the insoluble soaps are calcium soaps.

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II

THE SOLUBILITY OF CALCIUM SOAPS IN BILE

It will be seen from the preceding data that the proper utilization of fats by the type of infants under discussion is not a question of digestion, as has quite commonly been supposed, but rather a question of the proper absorption and assimilation of the soaps formed by the fatty acids which are produced by the digestion of fats. These soaps must be absorbed before they can be assimilated, and in order to be absorbed and pass through the intestinal wall into the body fluids they must be soluble in the intestinal juices, or, more definitely speaking, soaps must be soluble in bile in order to be absorbed and assimilated.

Cow's milk contains a large amount of calcium which is carried into the intestines with the other ingredients of the milk and is available for the formation of calcium soaps as soon as the fats are hydrolized by the fat-splitting ferments present in the intestinal juices. It is evident, therefore, that the absorption and assimilation of the digested fats will depend to a very great extent on the solubility in bile of the calcium soaps formed by the fatty acids produced as a result of the digestion of fats. In order to learn something of the solubilities of the calcium soaps of the fatty acids present in the fat of cow's milk, we have performed the following experiments.

A. Pure better fat was saponified by boiling under a reflux condenser with sodium ethylate. The sodium soaps thus obtained were purified and obtained in the dry condition. This mixture of soaps was very soluble in fresh ox bile, but on adding a drop of a 10 per cent. solution of calcium chlorid a heavy cloud was at once formed which settled out as a precipitate on standing. This precipitate was found to be calcium soaps.

B. Some of the mixed soaps as obtained under *A* were separated by the usual method of distillation into two fractions, the volatile fatty acids and the nonvolatile fatty acids. These two fractions were then converted into sodium soaps, the soaps being obtained in the dry condition. Both fractions were readily soluble in fresh ox bile, and on the addition of a drop of calcium chlorid the bile containing the soaps of the nonvolatile fatty acids gave a heavy precipitate, while the bile containing the soaps of the volatile fatty acids remained perfectly clear.

This difference in the solubilities of the calcium soaps formed by volatile and nonvolatile fatty acids has special significance when it is remembered that soaps of the volatile fatty acids are not found in infants' stools in more than traces except in the case of diarrheas.

In Table 5 will be found a statement of the kind and quantity of fatty acids produced by the saponification of 100 gm. of butter fat. It will be noticed that the oleic and palmitic acids together constitute over 71 per cent. of the total fatty acids thus produced, and offers some explanation for the finding previously noted that the soaps in infants' stools are soaps of oleic and palmitic acids.

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TABLE 5.—MOLECULAR WEIGHTS, MELTING POINTS AND AMOUNTS OF FATTY ACIDS OBTAINED BY THE SAPONIFICATION OF 100 GM. OF BUTTERFAT[1]

Name	Formula	Molecular Weights	Amounts, Gm.	Melting Points, C.
Dioxystearic acid	$C_{18}H_{36}O_4$	316	1.00	136.0
Oleic acid	$C_{18}H_{34}O_2$	282	32.50	14.0
Stearic acid	$C_{18}H_{36}O_2$	284	1.83	69.2
Palmitic acid	$C_{16}H_{32}O_2$	256	38.61	62.0
Myristic acid	$C_{14}H_{28}O_2$	228	9.89	54.0
Lauric acid	$C_{12}H_{24}O_2$	200	2.57	43.6
Capric acid	$C_{10}H_{20}O_2$	172	0.32	31.4
Caprylic acid	$C_8H_{16}O_2$	144	0.49	16.0
Caproic acid	$C_6H_{12}O_2$	116	2.09	—2.0
Butyric acid	$C_4T_8O_2$	88	5.45	—2.0

We have tried to learn something about the solubilities in bile of the calcium soaps of the nonvolatile fatty acids present in butterfat. This work is not completed as yet and the results so far obtained are rather inconclusive, but we believe calcium oleate shows a higher degree of solubility in bile at 37 C. than do the calcium soaps of stearic, palmitic or myristic acids. If this proves to be true the preponderance of the calcium soap of palmitic acid over the other soaps present in infants' stools will be readily explained.

III

THE CALCIUM CONTENT OF COW'S MILK IN ITS RELATION TO THE DIGESTION AND ABSORPTION OF FATS IN BOTTLE-FED INFANTS

So far as we know, no one before this has pointed out the important relation which exists in infant feeding between the calcium content of food and the elimination of calcium soaps in the stools. In this connection it should be understood that it is not the mere presence of calcium salts in the food which predetermines the presence of calcium soaps in the stools, for there are other factors entering into the question, such as: the forms in which the calcium is present in the food; bacterial activity within the intestines; and the amount of hydrochloric acid secreted into the stomach which may change certain forms of calcium compounds (that is, dicalcium phosphate) from an inactive to an active condition. In Table 6 will be found a statement of the different forms of calcium compounds found in cow's milk, and in Table 7 will be found data showing the influence of the different kinds of calcium salts (that is, insoluble, colloidal and soluble calcium compounds) on the elimination of calcium soaps in the stools from infants. A study of this table will show that the elimination of calcium soaps in the stools increases directly in proportion to the degree of solubility of the calcium present in the food.

1. Brown: Jour. Am. Chem. Soc., 1899, **21,** 807.

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TABLE 6.—CONDITION OF CALCIUM IN COW'S MILK AND HUMAN MILK

	Grams Per 100 C.c.	
	Cow's Milk	Human Milk
Calcium as insoluble phosphate ($CaHPO_4$)	0.051	None
Calcium combined with proteins	0.058	0.014
Calcium as soluble salts in serum (whey)	0.045	0.021

TABLE 7.—SHOWING INFLUENCE OF KIND OF CALCIUM SALTS PRESENT IN FOOD ON THE AMOUNT OF CALCIUM SOAPS ELIMINATED IN THE STOOLS

Lab No.	101—6	122—6	67	78—8	77—1
Age, months	6	4	4	3½	6
Kind of food	Synthetic	Synthetic	Synthetic	Synthetic	Milk
Formula	3-6-1.5	3-6-1.6	2-6-2	2-6-2	2-6-2
Calcium present as	None	$CaHPO_4$	Calcium caseinate	Calcium caseinate and acetate	Milk salts
Grams CaO, per 24 hours	0.00	0.45	0.51	1.55	1.13
Grams P_2O_5					
Per 24 hours	0.29	0.68*	0.38	0.38	1.71
In feces per 24 hrs.					
Grams fat	0.53	1.36	2.14	7.90	5.01
Grams CaO	0.10	0.33	0.48	1.73	0.94
Grams P_2O_5	0.04	0.44	0.31	0.39	0.36
In urine per 24 hrs.					
Grams CaO	Trace	0.02	0.00	0.20	0.06
Grams P_2O_5	0.30	0.28	0.00	0.00	0.82

* P_2O_5 in casein 0.23
P_2O_5 in $CaHPO_4$ 0.45
Total P_2O_5 ..... 0.68

It will be noticed from the tables that the dicalcium phosphate is practically inactive, as has been shown by us in a previous paper,[2] all the phosphorus fed as phosphate being recovered in the feces and the phosphorus contained within the casein being absorbed and appearing in the urine. In the case of the foods which contained calcium caseinate, and calcium caseinate plus calcium acetate, it will be seen that the urine became phosphorus free, all the phosphorus in the food being precipitated in the intestines as calcium phosphate and appearing in the feces. This question of phosphorus metabolism in relation to the calcium content of the food is one of very great importance and is being studied in this laboratory.

FAT DIGESTION AND ABSORPTION WHEN RECONSTRUCTED MILK IS FED TO INFANTS

Our investigations on infant feeding have led us to believe that many of the troubles encountered with bottle-fed infants receiving cow's milk must be attributed to the ill effects produced by the calcium in cow's milk.

2. Bowditch and Bosworth: Boston Med. and Surg. Jour., 1917, **177,** 864.

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Breast milk is nature's food for the infant, and we may consider the constituents to be so balanced as to meet all the demands of growth, with a minimum of waste. Cow's milk, on the other hand, is nature's food for the offspring of the cow, and is not balanced in any respects as a food for infants, and its use as such must usually be preceded by some form of modifying which will make the quantitative relations between the fat, sugar, protein and water approximately that found in breast milk. In most, if not all, of these modified cow's milks the mineral elements present receive very little consideration, being passed over with the statement that modified cow's milk will always contain a larger percentage of ash than breast milk, and hence will furnish all the mineral elements necessary. The time has come, however, when this phase of the feeding problem can no longer be treated in this manner, and more care must be taken to see that the mineral elements are properly balanced. This adjustment must take into consideration not only the mineral elements themselves, but also their relations to the organic constituents of the food.

Metabolism studies made in this connection must be based on the fundamental assumption that the metabolism of the healthy, normal breast-fed infant shall be used as the standard for comparison, and it must be admitted that no infant fed on cow's milk or any of its modifications can present a picture of a normal metabolism. The fact that a great number of children are successfully fed on cow's milk is no justification for assuming that they present a normal metabolism, for although they may be developing and growing in a normal manner, they are doing so on an abnormal food, not the one provided for them by nature, which necessarily predetermines that an abnormal metabolism must be going on in order that they may handle this abnormal food.

The presence of large quantities of calcium soaps in the stools from bottle-fed infants receiving cow's milk is one of the striking abnormalities noticed when a comparison is made between the analyses of such stools and those from breast-fed infants. As these soaps are insoluble, they can not act as suppository in a manner similar to the sodium and potassium soaps, and as a matter of fact they often cause severe constipation, which, in our estimation, is the starting point for other complications. In studying this type of cases it soon became apparent that the removal of most of the calcium from the cow's milk presented the only possibility for the working out of a successful method of feeding them. It was at first thought that the use of sodium or potassium caseinate with whey and heavy cream would prove of some value, but the soluble calcium salts present in the whey were sufficient to cause the formation of large amounts of calcium soaps.

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We have finally perfected a method for reconstructing cow's milk which permits us to remove nearly all the calcium from the original milk. This reconstructed milk posssesses the advantage of a great range in its composition, as will be seen by the figures in Table 8, in which we give the composition of cow's milk, human milk and the possibilities for our reconstructed milk.

TABLE 8.—SHOWING COMPOSITION OF COW'S MILK, BREAST MILK AND RECONSTRUCTED MILK (B. F. H. FORMULA)

	Cow	Breast	Reconstructed
Fat	3.90	3.30	Any per cent. desired.
Protein	3.20	1.50	Any per cent. desired.
Sugar	4.90	6.50	Any per cent. above 2.6
Salts	0.90	0.31	(0.33)
Ash	0.70	0.20	(0.21)
Citric acid	0.24	0.11	0.17
Chlorin	0.08	0.04	0.05
Phosphorus (inorganic)	0.09	0.014	0.001 or more if desired
Potassium	0.12	0.07	0.007
Sodium	0.05	0.02	0.033
Calcium	0.14	0.03	0.009 or more if desired
Magnesium	0.012	0.003	0.008

The details for the preparation of our reconstructed milk will not be given here, for we intend to present this subject in another paper. We can say, however, that its use in all the cases so far tried has produced favorable results, and in certain cases, such as those classed as "fat intolerance" and "infantile atrophy," improvement has resulted from its use, the following case being typical.

This child always eliminated free fatty acids, neutral fats and soaps in his stools whenever a modified milk formula containing 1 per cent. or more of a fat was fed; he was always constipated and the continued ingestion of a formula containing 1 per cent. or more of fat invariably resulted in a so-called "blow up" which was always ameliorated by the withholding of fats. When our reconstructed milk was fed to this child he could digest and absorb 3 per cent. of butterfat, eliminating a stool practically free of fat, fatty acids or soaps, and his general condition improved while he received this food.

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