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STUDIES OF THE VALUES OF DIFFERENT GRADES OF MILK IN INFANT FEEDING. III

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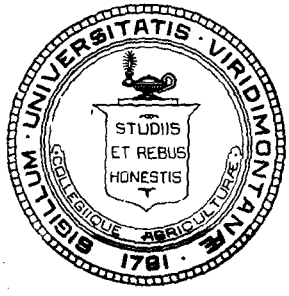

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The relative values of normal cows' milk, evaporated milk, powdered whole milk (two brands) and remade milk for infant feeding were studied in trials with baby pigs.

Comparisons based on animal vigor, on total gain, on the amount and economy of dry matter gain and on the body composition show that the several rations were efficient in the following order: Normal milk, evaporated and powdered milk (brand 2) remade and powdered milk (brand 1).

Marked changes in body composition occur with increase in age. Baby pigs at birth are made up largely of water and protein comprises the greater part of their dry matter content. However, as age advances the dry matter and fat percentages increase rapidly. The percentage of dry matter in a well developed pig at weaning age is approximately 50 percent greater and of fat 150 percent greater than at birth.

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I. PURPOSE OF THE TRIALS

This Station published in 1916 the results of a study made by Washburn and Jones (12) on the feeding value of various grades of cows' milk for the human infant, using pigs four to five weeks' old at the beginning of the trials. It covered the usage of normal cows' milk, sweetened condensed milk, evaporated milk, milks of different fat contents and homogenized milk. It is generally held by nutritionists that the results attained with young pigs may be applied to the feeding of the human infant because of the physiological similarity of their digestive systems. The present publication sets forth the results secured in similar trials with pigs only two days old at the beginning of the trials. It was felt that the younger the pig the nearer would be the similarity of its life stages to that of the human infant. It is recognized of course that a pig at birth is more fully developed than is the babe and that it matures more rapidly; however, it may be assumed with some degree of assurance that each week of early porcine life approximately corresponds to two to three months of an infant's life. Few pigs were fed more than five weeks, which period would resemble the initial year in human life.

The feeding values of (1) evaporated milk, (2) whole milk powder, (3) remade milk (unsalted butter and skimmilk, emulsified) were compared with that of normal cow's milk, comparisons being predicated upon the evidences of thrift and vigor while on trial as well as on the chemical analyses of the carcasses.

II. REVIEW OF LITERATURE

Washburn and Jones (12) (1916) fed young pigs and found that while evaporated milk compared favorably with normal cows' milk sweetened condensed milk produced a dangerously fat body and that milk with a medium fat content was preferable to that carrying either a low or high fat content.

Price (11) (1920) published a preliminary report on the comparative value of "Dried Milk Powder in Infant Feeding." The data were

The writers are indebted to Dr. H. B. Ellenberger, Station Animal and Dairy Husbandman, for advice and suggestions in planning and conducting these trials.

secured through the cooperation of the United States Public Health Service, the Boston Baby Hygiene Association, the Boston Health Department and several other agencies. Infants who were entirely artificially fed and were less than six months old were studied in their homes. They were divided into three groups according to the kind of food used: Group 1 consisted of babies whose milk was modified from grade A milk; group 2 consisted of babies fed on milk prepared from whole milk powder which was reconstituted in the homes; group 3 consisted of babies fed on milk reconstructed from unsalted butter and skimmilk powder. Admitting that gains in weight alone did not afford sufficient evidence on which to base final conclusions, the writer held that his results seemed to indicate that whole milk powder and commingled skimmilk powder and unsalted butter were useful in infant feeding, "and further—and especially in the case of the whole milk powder, and in the case of babies who are undernourished and who digest natural milk badly—these remade milks may have points of distinct advantage in infant feeding."

Coutts (2) (1920) put forth a most comprehensive and enlightening document regarding the use of milk powders in infant nutrition. His data were secured in many English and several French and Belgian cities and towns. He states that he is "of the opinion that, when breast feeding is impossible, dried milk is a very valuable food for infant feeding. It is perhaps one of the most generally useful of all the available preparations of cows' milk. It can be used successfully in the rearing of sound and healthy infants. For this purpose it is probably no better than, and may be slightly inferior to, pure, clean, fresh cows' milk, but pure fresh cows' milk is practically unobtainable in most towns and in view of the liability to bacterial changes in fresh milk when kept in the ordinary dwelling house, especially in hot weather, it is often desirable to use dried milk in preference."

Hart, Steenbock and Smith (5) (1919) conducted trials with guinea pigs as to the antiscorbutic properties of skimmilk powder, unsweetened condensed milk and raw milk and summarized their findings as follows:

1. "On a diet of rolled oats and hay, the prevention of scurvy by the use of raw milk will depend upon the amount of raw milk allowed.

2. "Commercial unsweetened condensed milk and the commercial milk powder examined had lost their antiscorbutic vitamins when used in quantities equivalent to an amount of raw milk which would prevent scurvy in guinea pigs on a diet of rolled oats and hay."

Osborne and Mendel (10) (1918) fed rats using dried whole milk as the source of water soluble vitamins and found that satisfactory and rapid growth was induced when the diet contained not less than 24 percent of powdered milk.

Winfield (13) (1920) fed rats exclusively on dried milk, either as a powder or in the form of a thick paste, together with as much water as they desired and found that dried milk used as the sole food maintained good health and permitted normal growth for periods much longer than those corresponding with human infancy and early childhood. He also made observations at infant welfare centers in Leeds and Sheffield on the growth of babies fed exclusively on dried milk and concluded that cows' milk during the process of dessication lost none of the characters which are necessary for the support of normal infant growth.

Marriott and Schoenthal (7) (1929) reported touching the results secured in feeding evaporated milk to infants at the St. Louis Children's Hospital and to the effect that unsweetened evaporated milk is the full equivalent in nutritive value of pasteurized or boiled whole milk, that its continued use as a routine food for normal infants is unattended by nutritional disturbances and that, when suitably modified, it is especially satisfactory for premature infants.

Ashton, Stringfield and Martin (1) (1929) summarized results obtained in feeding dried whole milk (supplemented with orange juice and cod-liver oil) to 100 babies for a whole year and stated that modifications of powdered whole milk can be used as a routine material in infant feeding in place of fresh whole milk modifications.

Nevens and Shaw (8) (1931) fed one lot of rats whole milk and another lot evaporated milk plus distilled water. The latter grew smoother and softer coats, displayed better appetites and lived longer than those fed fresh whole milk. Digestion trials showed that the fat of both whole and evaporated milk was more than 99 percent digestible, while the sugars were completely digested. However, the proteins of fresh whole milk were distinctly more digestible than those of evaporated milk. Later they (9) (1933) compared the digestibility of two commercial brands of powdered milk, one manufactured by the spray process and the other by the roller process, with that of fresh milk, using rats for the purpose. No significant differences were found in the apparent digestibility of the two powdered milks. Their fat and sugar contents were as digestible as those of fresh milk but their protein contents were significantly less digestible than that of

fresh milk. They point out, however, that "in view of the differences between individuals with respect to their tolerance for certain foods, it is entirely possible that in some cases the total nutritive effect of evaporated milk and of powdered milk may be more favorable than that of fresh whole milk."

De Sanctis and Craig (4) (1931) reported the results of a clinical study of 50 infants fed sweetened condensed milk in comparison with a control group of the same numbers receiving a cow's milk dilution. They held that sweetened condensed milk apparently met the nutritional needs of the normal infant but that the dilutions ordinarily used were too strong for the average infant.

III. PROCEDURE

The pigs used in these trials, usually seven to nine at a time, were removed from the sows two days after birth, weighed and marked for identification and placed in a small building especially designed and equipped for this project. This was always done in the evening so that by fasting during the night they would be ready for their first feeding in the morning.

The following morning one (occasionally two) was taken to the laboratory for slaughter and analysis, the results to be used as a check for that litter. The others were divided into two lots, generally of equal numbers and as nearly as possible of the same weights, one lot of which was fed normal cows' milk and the other the grade of milk under trial. Each pig was weighed twice daily. Usually two pigs, one from each lot, were killed and analyzed when their weights had doubled, two more when they had trebled, and the remainder of each lot when four or five weeks old, at which time they had at least quadrupled their weights.

Feeding methods.—The pigs were bottle-fed throughout their entire short lives. They readily learned to take the milk in this manner. The question arose as to how often to feed them, hence the frequencies that young pigs suckle were studied. Five sows, as they farrowed, were watched constantly for 24 hours twice a week, noting the number of times the pigs suckled and the duration of the suckling periods. This procedure was continued until the pigs were three to four weeks old. The average interval between each meal was found to be 50.5 minutes, and was practically the same throughout the entire period, the pigs suckling no oftener during the first than during the fourth week and

nearly as often during the night as in the day time. The average duration of each meal was between three and four minutes.

With these results in mind, a few preliminary trials were made wherein baby pigs were artificially fed at intervals of one, one and one-half and two hours. A regular procedure was then instituted of feeding at one and one-half hour intervals from 6 A.M. to 6 P.M. and at 9 P.M., midnight and 3 A.M. during the first four or five days and at 9 P.M. and 3 A.M. thereafter. The amount to be fed at each meal to each pig was computed and recorded in cubic centimeters. Each animal was given an amount proportioned to its weight, which amount was increased every one to three days according to live weight increment. The milks were kept iced so that wholesome sweet milk, warmed before feeding, was always available.

The amounts fed daily were calculated to be all that could be taken to advantage. Lusk (6) quotes Rubner as saying that the number of Calories[1] of food necessary to double the weight of the newly born of all species (except man) is the same per kilogram whether the rate of growth of the species is fast or slow. To construct one kilogram of normal body substance, 4,808 Calories are required, except in the case of man where six times that amount is needed. It was found in preliminary trials at this Station that young pigs fed under these conditions doubled their weight from birth in 10 to 14 days. Hence, using these data—the average number of days in which young pigs double their weight, and 4,808 Calories for one kilogram gain, or 4.8 Calories for one gram gain—a table was made showing the theoretical amount of milk proportional to the weight of the animal that each pig should receive during a period of 24 hours in order that it might double its weight in average time.

IV. THE CHECK PIGS

Sixteen two-day old pigs representing 15 litters were killed and their carcasses analyzed at the beginning of the several trials in order that the data thus secured might be used as a check in relation to the composition of the pigs experimentally fed. Table 1 gives these analyses. The infant pigs were made up largely of water since this con-

[1] *Calorific Value of Milk.*—A Calorie is the amount of heat required to raise the temperature of one kilogram of water from 0° C to 1° C. In calculating the calorific value of the milks the following values were assigned to the different food constituents: protein and carbohydrates, each 4.1 Calories per gram, and fat 9.225 Calories per gram. Fat possesses a calorific food value of approximately 2.25 times that of protein or carbohydrates due to its high content of carbon and hydrogen. Thus, if the composition of a milk is known, its calorific food value can be computed by adding the percentages of the three nutrients, protein, carbohydrates and (fat × 2.25), then multiplying the sum by 4.1. This result gives the number of Calories in 100 grams of food. In this manner the food value of all the milks used in these trials was determined.

stituent comprised nearly four-fifths and the dry matter but slightly over one-fifth of their bodies. The dry matter contained a little over 60 percent of protein and nearly 17 percent each of ash and fat. Checks 13 and 14 were from the same litter and the results obtained show a fairly close similarity in composition of pigs from the same litter. The others, all from different litters, show a wide range in composition, mainly in the fat content. These variations may be readily noted by the "ratios of fat to protein," the wide ratios indicating lean pigs and, conversely, the narrow ratios fatter animals. In general the smaller pigs contained the least fat in proportion to protein and vice versa. For example, the average ratio of fat to protein of three small pigs (Nos. 1, 46, 88) was 1:5.22 and of the three large ones (Nos. 34, 55, 63) it was 1:2.21. The average for all the pigs was 1:3.61. The weights of these infant pigs varied from 622 to 1,443 grams, or from a little under 1.5 to slightly over 3 pounds, the average being 1,029 grams or 2.3 pounds.

Washburn and Jones (12) analyzed the carcasses of 24 pigs four to five weeks old averaging 18.5 pounds in weight, all of whom had received only their own mothers' milks (table 2). Comparing these analyses with those in table 1, it will be noted that the main differences occur in the dry matter and the fat figures. In the older pigs the average dry matter percentage was 55 percent and the average fat (dry basis) percentage 157 percent greater than in the infant pigs. The average protein percentage, however, was higher in the younger pigs by 33 percent. The ratios of fat to protein also showed significant changes. In the infant pigs the ratio was 1:3.61, while in the older pigs the amounts of fat and protein were nearly equal and the ratio 1:1.05.

TABLE 1.—CHEMICAL COMPOSITION OF CARCASSES OF CHECK PIGS (TWO DAYS OLD)

Pig number	Trial	Weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
						Ash	Protein	Fat	Ash	Protein	Fat	
		grams	%	%		%	%	%	%	%	%	1:
1	Normal vs.	708	78.68	21.32	369.04	3.71	12.09	4.20	17.42	56.71	19.71	2.88
2	evaporated	997	78.20	21.80	358.71	3.60	13.92	2.93	16.52	63.87	13.44	4.75
13	milk	981	79.79	20.21	394.80	3.81	13.05	2.13	18.86	64.55	10.54	6.12
14		1,177	80.33	19.67	408.38	3.47	12.18	2.08	17.62	61.94	10.58	5.85
Average		966	79.34	20.66	384.03	3.63	12.84	2.70	17.59	62.13	13.07	4.75
23	Normal vs.	1,052	75.81	24.19	313.39	4.08	13.90	5.54	16.86	57.45	22.91	2.51
28	powdered	1,016	80.59	19.41	415.19	3.19	12.69	2.39	16.43	65.37	12.32	5.31
29	milk No. 1	1,024	79.79	20.21	394.69	2.78	12.89	3.41	13.70	63.77	16.86	3.78
34		1,271	78.58	21.42	366.85	3.11	13.10	4.11	14.51	61.15	19.21	3.18
Average		1,091	78.66	21.34	368.60	3.29	13.15	3.89	15.40	61.61	18.23	3.38
46	Normal vs.	745	79.30	20.70	383.09	4.66	12.40	1.60	22.50	59.92	7.72	7.76
52	powdered	1,161	79.22	20.78	381.23	3.67	13.27	2.52	17.65	63.86	14.75	4.33
55	milk No. 2	1,368	74.50	25.50	292.15	3.08	13.46	8.03	12.10	52.81	31.51	1.68
Average		1,091	77.27	22.73	339.95	3.65	13.16	4.61	16.05	57.88	20.30	2.85
62	Normal vs.	1,001	78.37	21.63	362.32	3.42	13.32	3.94	15.80	61.57	18.20	3.38
63	remade milk	1,443	75.54	24.46	308.83	3.71	13.35	6.24	15.18	54.56	25.50	2.14
72		957	79.81	20.19	395.29	3.79	13.81	1.39	18.79	68.43	6.88	9.95
82		934	80.02	19.98	400.50	3.38	12.89	2.08	16.93	64.52	10.40	6.20
88		622	82.57	17.43	473.72	3.39	12.09	1.43	19.46	69.37	8.21	8.45
Average		991	78.66	21.34	368.60	3.57	13.19	3.45	16.71	61.80	16.16	3.82
Grand average		1,029	78.54	21.46	365.98	3.52	13.09	3.62	16.42	61.00	16.88	3.61

TABLE 2.—CHEMICAL COMPOSITION OF CARCASSES OF CHECK PIGS (FOUR OR FIVE WEEKS OLD)

Pig number	Weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
1	8,951	65.90	34.10	193.25	3.51	16.37	14.39	10.29	48.01	42.20	1.14
2	8,093	65.29	34.71	188.10	3.64	16.81	14.31	10.49	48.43	41.23	1.17
17	7,860	67.84	32.16	210.94	3.36	15.50	12.81	10.45	48.20	39.83	1.21
25	6,950	67.96	32.04	212.10	3.29	14.13	14.15	10.27	44.10	44.16	1.
40	5,954	74.42	25.58	290.93	3.05	15.25	6.98	11.92	59.62	33.25	1.79
41	7,101	74.68	25.32	294.94	3.22	16.56	5.08	12.72	65.40	20.06	3.26
48	5,895	69.63	30.37	229.27	2.79	14.19	12.25	9.19	46.72	40.34	1.16
55	7,515	68.75	31.25	220.	3.06	15.31	12.53	9.79	48.99	40.10	1.22
59	10,409	65.67	34.33	191.29	3.11	13.88	16.75	9.06	40.43	48.79	0.83
69	8,529	70.01	29.99	233.44	2.99	14.81	11.89	9.97	49.38	39.65	1.25
76	9,461	62.98	37.02	170.12	3.13	14.63	18.94	8.45	39.52	51.16	0.77
83	12,244	64.63	35.37	182.72	3.15	15.81	16.05	8.91	44.70	45.38	0.99
90	9,957	63.42	36.58	173.37	3.29	15.63	17.26	8.99	42.73	47.18	0.91
97	9,357	67.02	32.98	203.21	3.52	15.44	13.78	10.67	46.82	41.78	1.12
104	11,408	67.38	32.62	206.56	3.34	15.63	13.51	10.24	47.92	41.42	1.16
111	13,183	64.54	35.46	182.	3.12	15.25	17.71	8.80	43.01	49.94	0.86
117	5,141	65.47	34.53	189.60	4.08	15.06	14.85	11.82	43.61	43.01	1.01
124	5,595	70.23	29.77	235.90	4.06	15.50	9.59	13.64	52.07	32.21	1.62
132	10,097	64.53	35.47	181.92	2.84	15.81	15.44	8.01	44.57	43.53	1.02
139	8,545	67.98	32.02	212.30	2.86	15.81	12.67	8.93	49.38	39.57	1.25
146	7,553	69.17	30.83	224.36	2.77	15.06	12.66	8.98	48.85	40.74	1.20
153	6,101	61.95	38.05	162.81	2.51	14.56	20.36	6.60	38.27	53.51	0.72
160	7,566	62.92	37.08	169.68	2.55	14.81	19.24	6.88	39.94	51.89	0.77
167	6,359	63.38	36.62	173.08	3.09	14.44	17.87	8.44	39.43	48.80	0.81
Average	8,326	66.62	33.38	199.58	3.17	15.30	14.51	9.50	45.84	43.47	1.05

Since these four to five weeks' old check pigs had received no food other than sow's milk and since their average age compared closely to the average age at the time of slaughter of many of the pigs used in the trials now under discussion, it would seem that this fat to protein ratio (1:1.05) might be taken as the norm for the present feeding trials. Thus a comparison of the chemical composition of the carcasses of the pigs fed in the various trials with the average analyses of the carcasses of the four to five weeks' old check pigs enables one to form some idea of the feeding values of the several milks used in these trials.

V. Normal Whole Milk vs. Evaporated Milk

The first trial compared normal cows' milk and evaporated milk. Three litters, 22 pigs, were used. Four of the 22 were used as checks, nine were fed normal and nine evaporated milk. The 18 were fed from 12 to 36 days, a total of 418 pig-days.

Milks—The evaporated milk fed was a standard commercial brand, its analysis being given in table 3. It was diluted by mixing equal parts by weight of water and milk, thus lowering the percentage of each solid constituent by one-half. This half and half mixture closely resembled the composition of a normal 3.8 percent milk. This dilution was used throughout the trials and its calorific value was thus kept constant. The normal milk used was practically all Holstein milk. A fresh supply was obtained daily. Fat tests were run on each lot and twice a week complete analyses were made. The average analytical data appear in table 3. The average compositions of the diluted evaporated and normal whole milks were meant to be as nearly alike as possible, but the normal milk proved to be of a somewhat lower composition in several of its solid constituents than the evaporated milk. However, such variations as occurred were compensated for in Calory computations.

Table 3.—Composition of evaporated and normal cows' milks

Milk	Water	Total solids	Ash	Protein	Milk sugar	Fat
	%	%	%	%	%	%
Evaporated	71.51	28.49	1.54	7.20	12.10	7.65
Normal	87.83	12.17	0.64	2.94	5.02	3.57
Evaporated (as fed)	85.75	14.25	0.77	3.60	6.05	3.83

Growth.—All the pigs lived and for the most part were vigorous and thrifty. Food consumption was quite regular, excepting that at times the pigs on evaporated milk did not take the full amounts prescribed by the schedule. Table 4 shows growths, table 5 averages.

TABLE 4.—GROWTH OF YOUNG PIGS

	Litter 1						Litter 2			
	Normal milk No. 3	Evaporated milk No. 4	Normal milk No. 5	Evaporated milk No. 6	Normal milk No. 9	Evaporated milk No. 10	Normal milk No. 7	Evaporated milk No. 8	Normal milk No. 11	Evaporated milk No. 12
1. Initial weight, grams	1,172	1,022	1,418	1,230	1,200	1,318	1,161	1,007	1,342	1,275
2. Final weight, grams	2,903	2,401	5,402	4,506	7,992	6,894	2,835	2,471	5,530	4,536
3. Live weight gain, grams	1,731	1,379	3,984	3,276	6,792	5,576	1,674	1,464	4,188	3,261
4. Dry matter gain, grams	557	442	1,346	1,113	2,407	1,907	458	377	1,360	1,021
5. Days fed	14	14	22	22	31	31	12	12	22	22
6. Average daily gain, grams	124	99	181	149	219	180	140	122	190	148
7. Percentage gain	148	135	281	266	566	423	144	145	312	256
8. Calories fed[1]	8,103	7,197	19,455	17,195	30,927	29,052	6,661	6,028	19,037	15,473
9. Calories per gram live weight gain	4.68	5.22	4.88	5.25	4.55	5.21	3.98	4.12	4.55	4.74
10. Calories per gram dry matter gain	14.55	16.28	14.45	15.45	12.85	15.23	14.54	15.99	14.	15.15

TABLE 4.—GROWTH OF YOUNG PIGS—*Concluded*

	Litter 3							
	Normal milk No. 15	Evaporated milk No. 16	Normal milk No. 17	Evaporated milk No. 18	Normal milk No. 19	Evaporated milk No. 20	Normal milk No. 21	Evaporated milk No. 22
1. Initial weight, grams	1,495	1,402	1,455	1,244	1,281	1,520	1,525	1,610
2. Final weight, grams	3,465	3,204	5,487	4,665	8,430	8,065	9,529	8,754
3. Live weight gain, grams	1,970	1,802	4,032	3,421	7,149	6,545	8,004	7,144
4. Dry matter gain, grams	647	606	1,330	1,046	2,604	2,393	2,898	2,329
5. Days fed	13	13	26	26	33	33	36	36
6. Average daily gain, grams	152	139	155	132	217	198	222	198
7. Percentage gain	132	129	277	275	558	431	525	444
8. Calories fed[1]	9,014	9,325	20,056	18,039	34,858	37,704	41,167	37,960
9. Calories per gram live weight gain	4.58	5.17	4.97	5.27	4.88	5.76	5.14	5.31
10. Calories per gram dry matter gain	13.93	15.39	15.08	17.25	13.39	15.76	14.21	16.30

[1] Computed from composition by following formulas: calorific values per gram, protein 4.1, carbohydrates 4.1, and fat 9.225.

TABLE 5.—GROWTH OF YOUNG PIGS

Average of litters 1, 2 and 3	Normal milk (average 9 pigs)	Evaporated milk (average 9 pigs)
1. Initial weight, grams	1,339	1,292
2. Final weight, grams	5,730	5,055
3. Live weight gain, grams	4,391	3,763
4. Dry matter gain, grams	1,511	1,248
5. Days fed	23.2	23.2
6. Average daily gain, grams	189	162
7. Percentage gain	328	291
8. Calories fed	21,031	19,775
9. Calories per gram live weight gain	4.79	5.26
10. Calories per gram dry matter gain	13.92	15.85

The average initial weights of the pigs fed normal and of those fed evaporated milks were fairly close, the former having a small advantage (47 grams) over the latter. However, their final weights were 700 grams greater. The normal milk-fed pigs gained nearly 17 percent more in live weight and over 21 percent more in dry matter than did those fed evaporated milk. This relatively low gain made by the evaporated-milk-fed pigs was due in part to a lesser number of food Calories consumed. They were offered as much food as the normal milk-fed animals but did not always take the full amounts prescribed. Nevertheless, the evaporated milk was less efficient than the normal milk as shown by the number of food Calories required per unit of gain whether of live weight or of dry matter. The average number of Calories for one gram gain in live weight and the average number for one gram gain in dry matter in case of the pigs fed normal milk were respectively 4.79 and 13.92, whereas, the corresponding figures for the pigs fed evaporated milk were 5.26 and 15.85. In other words it required more food to produce a unit of gain when evaporated replaced normal milk, the food required per unit of dry matter gain in the evaporated milk being only 87.8 percent ($13.92 \div 15.85$) as efficient for growth as it was in the case of the normal milk.

Physical condition.—Both lots were made up of vigorous and active animals. They were "off feed" at times, the evaporated milk-fed group more so than its competitor, a condition which was soon remedied by substituting skimmilk during a few of the meals. The pigs fed evaporated milk scoured a little during early life but this ailment soon cleared up and they became as active and vigorous as those fed normal milk. When slaughtered, their carcasses were as solid and compact as those of the normal milk-fed group.

Comparison with pigs on sow.—In order to compare the rate of growth of these pigs with those on sow's milk, two litters, nine pigs in all, which were suckling their mothers, were weighed twice a day until their weights had trebled. The data thus obtained were then compared with those secured in the feeding trials.

TABLE 6.—RATE OF GROWTH OF PIGS ON SOWS' MILK, NORMAL COWS' MILK AND EVAPORATED MILK

	Average number days to double weight	Average number days to treble weight
Sows' milk, nine pigs	8.5	15
Normal cows' milks, nine pigs	11.	19
Evaporated milk, nine pigs	11.	20

The two trial groups made the same rate of gain at the outset, both lots doubling their weights in 11 days, but in trebling their weights the normal milk-fed animals slightly outdistanced those on evaporated milk, 19 days and 20 days being required, respectively. Both lots compared quite favorably with the rate of gain of the pigs on the sows, which, as might have been expected, made the more rapid gains, requiring but 8.5 and 15 days for doubling and trebling their weights. This more rapid gain may be attributed to natural feeding conditions and to the greater adaptability to their needs of mother's milk. Sows' milk is high in both protein and fat, higher than is cows' milk.

Table 7 shows the composition of sows' milk from samples secured at this Station, while table 8 gives analyses recorded elsewhere (3). The local samples exhibit considerable variations in composition and especially in fat content. The milk from sows 1 and 2 was taken under normal conditions as the sows were suckling full litters and these were removed two hours previous to drawing the samples. These analyses are quite similar to those recorded in table 8. The samples were obtained under abnormal conditions in the other cases, being drawn at random, when obtainable, and from sows suckling but one or two pigs, and show very high fat percentages.

TABLE 7.—COMPOSITION OF SOWS' MILK

Sow number	Water	Total solids	Ash	Casein and albumen	Sugar	Fat	Nutritive ratio
	%	%	%	%	%	%	1:
1	79.02	20.98	0.83	6.19	6.04	7.92	3.88
2	80.16	19.84	0.88	6.29	6.91	5.76	3.18
3	74.11	25.89	0.84	8.05	3.68	13.32	4.18
4	73.48	26.52	1.26	7.66	4.64	12.96	4.41
5	66.10	33.90	1.09	11.17	3.64	18.	3.95
6	74.68	25.32	0.82	7.54	4.	12.96	4.40

TABLE 8.—COMPOSITION OF SOWS' MILK

	Number of samples	Water	Total solids	Ash	Casein and albumen	Sugar	Fat	Nutritive ratio
		%	%	%	%	%	%	1:
Dietrich and Konig...	7	84.55	15.45	1.10	6.44	3.16	4.75	2.15
Henry and Woll.....	7	80.96	19.04	1.07	6.20	4.71	7.06	3.32
Carlyle and Woll.....	12	80.50	19.50	0.98	6.06	5.56	6.90	3.48
Carlyle and Woll.....	4	80.41	19.59	0.97	5.74	5.63	7.25	3.82
Davies	1	83.28	16.72	1.08	4.76	5.47	5.41	3.71
Average		81.94	18.06	1.04	5.84	4.91	6.27	3.26

Composition of carcasses.—Table 9 gives the chemical analyses of the carcasses. The average composition of the two lots (dry matter basis) did not vary materially. The dry matter was 4.1 percent higher in the normal milk-fed group than in its rival, but the ash, protein, fat percentages and the ratios of fat to protein were nearly identical in both groups.

Comparing these analyses with those of the check pigs Nos. 1, 2, 13, 14 (table 1) it will be seen that considerable change in body composition took place during the two to five weeks of feeding, the most outstanding differences being in the relative amounts of fat and protein. There was 4.75 times as much protein as fat in the carcasses of the two days' old pigs, whereas in those of the older pigs there was but 1.25 times as much. The dry matter also changed to a marked extent, as is readily seen by comparing the figures in the columns in the two tables headed "parts water per 100 parts dry matter." The carcasses of the check pigs, slaughtered when two days old, contained over 3.5 times as much water as dry matter, while those of the pigs fed for two to five weeks contained less than 2.5 times as much.

Table 10 exhibits the chemical composition of the live weight gains. These data were secured by taking the differences between the grams of dry matter, ash, protein and fat present in the carcasses at the close of

the feeding period, and the grams of the same constituents in the carcass of the check pig of that litter calculated to the initial weights of the experimental pig. Percentage compositions were then calculated from these figures.

These percentages follow closely those in table 9 being, of course, somewhat higher in dry matter. The gains in both lots were quite similar, those in the normal milk-fed group averaging higher than those in the other group in dry matter, ash and protein but lower in fat, the respective percentages being +3.8, +1.5, +1.5 and —3.

TABLE 9.—NORMAL WHOLE MILK VS. EVAPORATED MILK—CHEMICAL COMPOSITION OF CARCASSES

Pig number	Final weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
3	2,903	72.22	27.78	260.	2.99	15.11	9.07	10.78	54.38	32.66	1.67
5	5,402	69.49	30.51	227.8	2.93	15.05	12.06	9.61	49.32	39.52	1.25
7	2,835	74.91	25.09	298.6	2.95	14.42	6.84	11.74	57.49	27.28	2.11
9	7,992	66.68	33.32	200.1	2.88	15.38	14.70	8.64	46.17	44.11	1.05
11	5,530	70.11	29.89	234.6	2.70	14.81	11.77	9.04	49.54	39.39	1.26
15	3,465	72.73	27.27	266.7	3.24	15.51	7.76	11.87	56.87	28.45	2.
17	5,487	70.48	29.52	238.8	3.07	15.53	10.22	10.40	52.60	34.61	1.52
19	8,430	66.09	33.91	194.9	2.97	15.68	14.65	8.75	46.24	43.21	1.07
21	9,529	66.41	33.59	197.7	2.97	16.30	13.03	8.83	48.51	38.78	1.25
Average	5,730	68.77	31.23	220.2	2.95	15.46	12.10	9.45	49.50	38.75	1.28
				(Fed evaporated milk)							
4	2,401	72.52	27.48	263.9	3.66	14.89	8.34	13.31	54.17	30.34	1.79
6	4,506	69.48	30.52	227.6	2.63	14.59	12.52	8.61	47.81	41.04	1.16
8	2,471	75.85	24.15	314.1	3.04	13.95	6.33	12.58	57.77	26.21	2.20
10	6,894	68.27	31.73	215.2	2.96	15.76	12.35	9.32	49.65	38.91	1.28
12	4,536	71.37	28.63	249.3	2.49	13.84	11.55	8.69	48.36	40.33	1.20
16	3,204	72.38	27.62	262.1	3.14	14.78	9.	11.37	53.50	32.56	1.64
18	4,665	72.27	27.73	260.6	2.67	14.29	10.24	9.63	51.55	36.94	1.40
20	8,065	66.58	33.42	199.2	3.06	15.36	14.48	9.15	45.96	43.32	1.06
22	8,754	69.73	30.27	230.4	2.67	14.43	12.77	8.83	47.67	42.20	1.13
Average	5,055	70.01	29.99	233.4	2.87	14.76	11.76	9.56	49.23	39.20	1.26

TABLE 10.—NORMAL WHOLE MILK VS. EVAPORATED MILK—CHEMICAL COMPOSITION OF GAINS

Pig number	Weight of gain	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
3	1,731	67.85	32.15	211.	2.51	17.15	12.37	7.80	53.32	38.47	1.39
5	3,984	66.22	33.78	196.	2.65	16.10	14.85	7.86	47.66	43.97	1.08
7	1,674	72.63	27.37	265.4	2.49	14.77	9.56	9.10	53.97	34.92	1.55
9	6,792	64.56	35.44	182.2	2.73	15.97	16.55	7.70	45.05	46.70	0.96
11	4,188	67.52	32.48	207.9	2.41	15.09	14.61	7.42	46.46	44.96	1.03
15	1,970	67.16	32.84	204.5	2.94	17.73	12.05	8.96	53.99	36.68	1.47
17	4,032	67.01	32.99	203.1	2.87	16.59	13.14	8.71	50.30	39.85	1.26
19	7,149	63.58	36.42	174.6	2.85	16.23	16.90	7.82	44.58	46.41	0.96
21	8,004	63.80	36.20	176.2	2.84	17.01	15.11	7.86	46.97	41.73	1.13
Average	4,391	65.58	34.42	190.5	2.74	16.30	14.89	7.95	47.35	43.26	1.09
				(Fed evaporated milk)							
4	1,379	67.96	32.04	212.1	3.62	16.97	11.40	11.29	52.95	35.57	1.49
6	3,276	66.03	33.97	194.4	2.22	15.53	15.65	6.53	45.71	46.06	0.99
8	1,464	74.23	25.77	288.	2.65	13.98	8.67	10.28	54.23	33.63	1.61
10	5,576	65.81	34.19	192.5	2.78	16.62	14.27	8.12	48.61	41.74	1.16
12	3,261	68.69	31.31	219.4	2.05	13.82	14.92	6.55	44.14	47.65	0.93
16	1,802	66.39	33.61	197.5	2.76	16.49	14.36	8.22	49.06	42.72	1.15
18	3,421	69.43	30.57	227.1	2.32	14.92	13.20	7.60	48.80	43.18	1.13
20	6,545	63.44	36.56	173.5	2.93	16.01	17.35	8.01	43.79	47.47	0.92
22	7,144	67.40	32.60	206.8	2.46	14.85	15.18	7.54	45.54	46.55	0.98
Average	3,763	66.83	33.17	201.5	2.60	15.47	14.79	7.83	46.65	44.60	1.05

The close similarity in the chemical analyses of the carcasses of these two lots of pigs would seem to indicate that evaporated milk produced practically as good animal bodies as did normal milk.

A comparison of the data secured with these two lots with those secured on the older check pigs (table 2) indicates that both the normal milk-fed and the evaporated milk-fed pigs compared quite favorably in body development with these checks. The fat to protein ratios 1:1.28 and 1.26, respectively, approached quite closely to that of the check pigs, 1:1.05. Dividing both lots into three groups according to age (table 11) the respective ratios for the normal milk-fed lot are 1:1.92, 1.34 and 1.12 and for the evaporated milk-fed lot 1:1.81, 1.25 and 1.15. The latter exhibited narrower ratios than the former in groups 1 and 2 and a very slightly wider one in group 3. Both lots of the older pigs (group 3) contained nearly the same relative proportions of fat and protein as the check pigs. In no other trial did the data approximate as closely to those of the older checks.

TABLE 11.—RELATIVE AMOUNTS OF FAT AND PROTEIN IN CARCASSES ACCORDING TO AGE

Milk	Group 1 12 to 14 days				Group 2 22 to 26 days				Group 3 31 to 36 days			
	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein
	No.	%	%	1:	No.	%	%	1:	No.	%	%	1:
Normal	3	54.4	32.7	1.66	5	49.3	39.5	1.25	9	46.2	44.1	1.05
Normal	7	57.5	27.3	2.11	11	49.5	39.4	1.26	19	46.2	43.2	1.07
Normal	15	56.9	28.4	2.	17	52.6	34.6	1.52	21	48.5	38.8	1.25
	Ave.	56.3	29.4	1.92	Ave.	50.5	37.8	1.34	Ave.	47.	41.9	1.12
Evaporated	4	54.2	30.3	1.79	6	47.8	41.	1.17	10	49.7	38.9	1.28
Evaporated	8	57.8	26.2	2.20	12	48.4	40.3	1.20	20	46.	43.3	1.06
Evaporated	16	53.5	32.6	1.64	18	51.6	36.9	1.40	22	47.7	42.2	1.13
	Ave.	54.8	30.3	1.81	Ave.	49.3	39.4	1.25	Ave.	47.7	41.6	1.15

VI. NORMAL WHOLE MILK VS. POWDERED WHOLE MILK

The second trial compared normal cows' milk with two well-known brands of powdered whole milk. The same general plan was followed in these trials as in those just discussed except that more pigs were fed on powdered than on normal milk in order to secure as much information as possible touching its nutritive value, since considerable data on the nutritive value of normal milk was in hand from the preceding trial. The amounts fed were reduced about one-fourth since several of the pigs heretofore fed did not take the prescribed amounts of milk.

Forty-seven pigs representing seven litters were used. Eight died, six of scours less than a week after removal to the experimental barn, one at the tender age of one day from hog cholera which was then prevalent at the University farm, and one when a month old, probably from uremic poisoning. The six that died of scours were from two litters from the same sow. Both litters were weak at birth, apparently suffering from malnutrition and did poorly from the start. Four were fed normal milk and two powdered milk. Those that lived, whether fed normal or powdered milk, as well as two that were left on the sow, went "off feed" and scoured quite persistently. This condition was doubtless due to some individual idiosyncrasy of the sow since other litters from other sows were not thus affected. The month-old pig that died of uremic poisoning was organically unsound and required much more food than its mates to make a unit of gain. The data

secured with the eight were obviously not representative and were excluded. Thus the final results are based on data obtained on 39 healthy pigs, 7 checks, 11 fed normal and 21 powdered milk.

A. Normal Milk vs. Powdered Milk No. 1

Four litters of 23 animals were fed, 13 being on powdered milk and six on normal milk while four were used as checks. They were fed from 18 to 42 days, representing 556 pig-days.

Milks.—The powdered whole milk was prepared in amounts sufficient for two days' feeding by combining definite amounts by weight of powder and water and thoroughly mixing the same with an emulsifier. Each two-day mixture was analyzed and its calorific value computed. A ratio of one part powder to seven of water was used with the first three litters, but a one to six mixture with the fourth. The average composition of the normal and diluted powdered milks are stated in the following table:

Table 12.—Average composition of normal and powdered whole milks

Milk	Water	Total solids	Ash	Protein	Milk sugar	Fat
	%	%	%	%	%	%
Normal	88.15	11.85	0.59	3.06	4.66	3.54
Powdered	86.81	13.19	0.65	3.22	5.82	3.50

Growth.—Table 13 gives growth data for each pig and table 14 summarizes that obtained on all four litters, six pigs fed on normal and 13 powdered milk. The two groups compared quite closely (table 14). The normal milk group weighed 38 grams more at the start and 225 grams more at the end of the feeding period than the powdered milk group, the excess gain being 187 grams. The former gained 6.9 percent more in live weight and 9.4 percent more in dry matter than the latter group and its rate of gain was slightly greater, averaging 119 grams daily as compared to 112 grams. The last two lines in table 14 show the efficiency of the gains. A few more Calories of food were required by the powdered milk-fed pigs for a unit of gain whether of live weight or dry matter, the corresponding figures being: normal 5.07, 17.43; powdered 5.24 and 18.46 per gram of live weight and per gram of dry matter. This brand of powdered milk was only 94.4 (17.43 ÷ 18.46) percent as efficient in inducing dry matter growth as was the normal milk.

Physical Condition.—Both lots were in good physical condition at the close of the trials and could not be thus distinguished one from the other. The pigs were equally fleshy and well filled out and had

TABLE 13.—GROWTH OF YOUNG PIGS

	Litter 1				Litter 2		
	Normal milk No. 26	Powdered milk No. 27	Powdered milk No. 25	Powdered milk No. 24	Powdered milk No. 30	Powdered milk No. 31	Powdered milk No. 35
1. Initial weight, grams	1,339	1,370	1,238	1,381	1,265	1,210	1,050
2. Final weight, grams	5,222	5,057	3,322	3,311	3,260	3,390	5,767
3. Live weight gain, grams	3,883	3,687	2,084	1,930	1,995	2,180	4,717
4. Dry matter gain, grams	1,140	986	506	473	519	517	1,400
5. Days fed	34	34	23	23	23	23	42
6. Average daily gain, grams	114	108	91	84	87	95	112
7. Percentage gain	290	269	168	140	158	180	449
8. Calories fed	21,728	19,814	10,821	11,635	11,318	11,034	25,842
9. Calories per gram live weight gain	5.60	5.37	5.19	6.03	5.67	5.06	5.48
10. Calories per gram dry matter gain	19.06	20.10	21.39	24.60	21.81	21.34	18.46

TABLE 13.—GROWTH OF YOUNG PIGS—*Continued*

	Litter 3				Litter 4							
	Normal milk No. 33	Powdered milk No. 32	Powdered milk No. 36	Powdered milk No. 37	Normal milk No. 38	Powdered milk No. 39	Normal milk No. 40	Powdered milk No. 41	Normal milk No. 42	Powdered milk No. 43	Normal milk No. 44	Powdered milk No. 45
1. Initial weight, grams	1,400	1,189	1,352	1,366	1,432	1,495	1,474	1,437	1,260	1,325	965	886
2. Final weight, grams	2,764	2,560	5,550	5,161	3,436	3,625	5,050	5,126	6,421	6,619	5,880	6,187
3. Live weight gain, grams	1,364	1,371	4,198	3,795	2,004	2,130	3,576	3,689	5,161	5,294	4,915	5,301
4. Dry matter gain, grams	377	395	1,231	1,102	541	548	1,021	1,099	1,568	1,602	1,434	1,658
5. Days fed	18	18	35	35	19	19	27	27	36	36	42	42
6. Average daily gain, grams	76	76	120	108	105	112	132	137	143	147	117	126
7. Percentage gain	97	115	311	278	140	142	243	257	410	400	509	598
8. Calories fed	8,360	7,174	22,675	19,587	8,891	9,639	16,403	17,737	25,823	26,304	24,745	28,592
9. Calories per gram live weight gain	6.13	5.23	5.40	5.16	4.44	4.53	4.59	4.81	5.	4.97	5.03	5.39
10. Calories per gram dry matter gain	22.18	18.16	18.42	17.77	16.43	17.59	16.07	16.12	16.47	16.42	17.26	17.24

TABLE 14.—GROWTH OF YOUNG PIGS

Average of litters 1, 2, 3 and 4	Normal milk (average 6 pigs)	Powdered milk (average 13 pigs)
1. Initial weight, grams	1,312	1,274
2. Final weight, grams	4,796	4,533
3. Live weight gain, grams	3,484	3,259
4. Dry matter gain, grams	1,013	926
5. Days fed	29.3	29.2
6. Average daily gain, grams	119	112
7. Percentage gain	266	256
8. Calories fed	17,658	17,090
9. Calories per gram live weight gain	5.07	5.24
10. Calories per gram dry matter gain	17.43	18.46

fine, smooth bristles. Four of the six fed on normal milk and all those fed on powdered milk were "off feed" once or twice, which condition was soon remedied by feeding skimmilk for a few meals.

Chemical Composition.—The chemical analyses appear in table 15. The pigs fed normal milk averaged slightly higher in dry matter than their mates. Their ash and fat contents (dry matter basis) were greater and their protein contents less than when powdered milk was fed. Expressed in terms of percentage these differences would be: dry matter +2.4, ash +1.3, protein —2.5 and fat +5.7. More fat in relation to the amount of protein was stored by the pigs fed normal than by those fed powdered milk as evidenced by the ratios of fat to protein, 1:1.75 and 1.90, respectively.

Table 16 shows the composition of the gains. The same relationships between the two groups obtain here as for the entire animal, the percentage differences being: dry matter +2.4, ash +3.9, protein —2.9 and fat +5.2. Clearly this brand of powdered whole milk was nearly equal to normal cows' milk in the production of animal tissue.

Table 17 gives the relative amounts of fat and protein in both lots by groups fed, respectively, to twice, thrice and four times their initial weights, the average ratios being, respectively, for the normal milk 1:2.97, 1.97 and 1.47, and for the powdered milk 1:2.67, 2.43 and 1.65. These figures may be compared to advantage with the data in table 2 on check four- to five-weeks-old pigs. The powdered milk-fed lot had the advantage in the first group (18 days) whereas the normal milk-fed lot surpassed its mate in the second and third groups (25 and 38 days). The ratios of both lots are much wider than those found in the preceding trial, which was probably due to the reduced quantities of milk fed which retarded the rate of growth and, perhaps, to litter individuality. However, this brand of powdered milk was not equal in feeding value to that used in the succeeding trial.

TABLE 15.—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK NO. 1—CHEMICAL COMPOSITION OF CARCASSES

Pig number	Final weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
26	5,222	71.97	28.03	256.8	2.90	13.94	10.51	10.34	49.74	37.51	1.33
33	2,764	76.12	23.88	318.8	2.92	15.08	5.29	12.23	63.13	22.13	2.85
38	3,436	75.32	24.68	305.2	3.56	15.65	5.08	14.42	63.42	20.59	3.08
40	5,050	73.53	26.47	277.8	2.84	15.47	7.87	10.71	58.47	29.72	1.97
42	6,421	71.38	28.62	249.4	3.50	14.93	9.82	12.22	52.19	34.31	1.52
44	5,880	72.11	27.89	258.6	3.15	14.65	9.42	11.29	52.51	33.78	1.55
Average	4,796	72.94	27.06	269.6	3.15	14.89	8.52	11.65	55.02	31.48	1.75
				(Fed powdered milk)							
24	3,311	75.61	24.39	310.	2.91	14.29	6.67	11.93	58.60	27.35	2.14
25	3,322	75.75	24.25	312.4	3.11	14.96	5.70	12.82	61.69	23.49	2.63
27	5,057	73.96	26.04	284.	3.07	15.27	7.25	11.77	58.64	27.85	2.11
30	3,260	76.55	23.45	326.4	2.93	15.05	4.60	12.48	64.17	19.63	3.27
31	3,390	77.83	22.17	351.1	2.80	14.24	4.12	12.63	64.24	18.56	3.46
32	2,560	75.20	24.80	303.2	3.14	15.58	5.49	12.66	62.83	22.13	2.84
35	5,767	72.19	27.81	259.6	2.96	14.15	10.29	10.64	50.90	37.02	1.37
36	5,550	72.90	27.10	269.	2.89	15.03	8.51	10.67	55.45	31.41	1.77
37	5,161	73.29	26.71	274.4	3.04	15.27	7.88	11.37	57.18	29.51	1.94
39	3,625	76.06	23.94	317.7	3.14	14.54	5.70	13.11	60.71	23.80	2.55
41	5,126	72.56	27.44	264.4	3.13	15.25	8.70	11.41	55.58	31.71	1.75
43	6,619	71.51	28.49	251.	3.15	14.37	10.15	11.06	50.45	35.63	1.42
45	6,187	70.13	29.87	234.8	3.14	15.84	10.19	10.52	53.02	34.11	1.55
Average	4,533	73.57	26.43	278.4	3.04	14.92	7.87	11.50	56.45	29.76	1.90

TABLE 16.—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK NO. 1—CHEMICAL COMPOSITION OF GAINS

Pig number	Weight of gain	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
26	3,883	70.65	29.35	240.7	2.49	13.96	12.23	8.49	47.55	41.66	1.14
33	1,364	72.35	27.65	261.7	3.06	17.32	7.21	11.08	62.65	26.09	2.40
38	2,004	73.	27.	270.4	3.88	17.47	5.77	14.36	64.68	21.38	3.03
40	3,576	71.46	28.54	250.4	2.72	16.45	9.41	9.53	57.63	32.97	1.75
42	5,161	69.62	30.38	229.2	3.59	15.38	11.21	11.83	50.64	36.91	1.37
44	4,915	70.83	29.17	242.8	3.16	14.95	10.46	10.82	51.26	35.88	1.43
Average	3,484	70.91	29.09	243.8	3.13	15.53	10.13	10.76	53.38	34.84	1.53

TABLE 16.—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK NO. 1—CHEMICAL COMPOSITION OF GAINS—*concluded*

Pig number	Weight of gain	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed powdered milk)							
24	1,930	75.48	24.52	307.8	2.07	14.56	7.48	8.45	59.40	30.50	1.95
25	2,084	75.72	24.28	311.9	2.53	15.59	5.79	10.44	64.20	23.84	2.69
27	3,687	73.27	26.73	274.1	2.69	15.78	7.89	10.05	59.04	29.52	2.
30	1,995	73.98	26.02	284.3	2.76	16.55	6.01	10.60	63.60	23.10	2.75
31	2,180	76.30	23.70	321.9	2.58	15.11	5.07	10.90	63.74	21.41	2.98
32	1,371	71.22	28.78	247.5	3.45	17.92	7.29	11.99	62.27	25.34	2.46
35	4,717	70.32	29.68	236.9	2.91	14.48	12.05	9.79	48.80	40.61	1.20
36	4,198	70.69	29.31	241.2	2.93	15.71	10.15	9.99	53.61	34.64	1.55
37	3,795	70.96	29.04	244.4	3.13	16.13	9.49	10.77	55.53	32.68	1.70
39	2,130	74.29	25.71	289.	3.16	15.54	6.81	12.29	60.45	26.49	2.28
41	3,689	70.21	29.79	235.7	3.14	16.09	10.49	10.54	54.02	35.22	1.53
43	5,294	69.74	30.26	230.5	3.16	14.69	11.66	10.45	48.55	38.54	1.26
45	5,301	68.72	31.28	219.7	3.15	16.30	11.21	10.06	52.09	35.82	1.45
Average	3,259	71.60	28.40	252.1	2.94	15.61	9.40	10.36	54.96	33.11	1.66

TABLE 17.—RELATIVE AMOUNTS OF FAT AND PROTEIN IN CARCASSES ACCORDING TO AGE

Milk	Group 1 18 to 19 days				Group 2 23 to 27 days				Group 3 34 to 42 days			
	Pig number	Protein	Fat	Ratio fat to protein	Pig number	Protein	Fat	Ratio fat to protein	Pig number	Protein	Fat	Ratio fat to protein
		%	%	1:		%	%	1:		%	%	1:
Normal	33	63.1	22.1	2.86	40	58.5	29.7	1.97	26	49.7	37.5	1.33
Normal	38	63.4	20.6	3.08					42	52.2	34.3	1.52
Normal									44	52.5	33.8	1.55
	Ave.	63.3	21.3	2.97	Ave.	58.5	29.7	1.97	Ave.	51.6	35.1	1.47
Powdered	32	62.8	22.1	2.84	24	58.6	27.4	2.14	27	58.6	27.9	2.10
No. 1	39	60.7	23.8	2.55	25	61.7	23.5	2.63	35	50.9	37.	1.38
No. 1					30	64.2	19.6	3.28	36	55.5	31.4	1.77
No. 1					31	64.2	18.6	3.45	37	57.2	29.5	1.94
No. 1					41	55.6	31.7	1.75	43	50.5	35.6	1.42
No. 1									45	53.	34.1	1.55
	Ave.	61.6	23.1	2.67	Ave.	60.3	24.9	2.42	Ave.	54.	32.8	1.65

B. NORMAL MILK VS. POWDERED MILK NO. 2

Sixteen pigs, representing three litters, were used, three as checks, five on normal and eight on powdered milk. They were fed from 17 to 31 days, representing 313 pig-days.

Milks.—A milk, richer in fat than that heretofore fed, was given to these pigs. Ayrshire replaced Holstein milk and the ratio of powder to water was 1:5.5 instead of 1:6 or 1:7. Table 18 gives the average compositions of the milks. Fat percentages were practically identical in the two milks but the other solid constituents were higher in the powdered milk. These differences, however, were compensated in computing the number of Calories of food that each animal received.

TABLE 18.—AVERAGE COMPOSITION OF NORMAL AND POWDERED WHOLE MILK

Milk	Water	Total solids	Ash	Protein	Milk sugar	Fat
	%	%	%	%	%	%
Normal	87.14	12.86	0.55	3.48	4.87	3.96
Powdered	85.18	14.82	0.69	3.99	6.16	3.98

Growth.—Table 19 displays the records made by each pig. In every comparable case those fed powdered milk made the greater gains, both in live weight and dry matter and, with one exception (No. 61, live weight), the most economical gains. Table 20 gives the averages of the three litters, five pigs on normal and eight on powdered milk. The initial weight of the powdered milk-fed animals was lower than that of the normal milk-fed pigs by 146 grams but their final weight was 269 grams greater. The former gained 14 percent more in live weight and 26.6 percent more in dry matter than the latter group. These larger gains were due in part to the greater number of days the powdered milk-fed lot were fed, 24.6 as compared to 23.2. Nevertheless, the average daily gain (line 6) made by the pigs on powdered milk was nearly eight percent above that of the animals on normal milk. Lines 9 and 10 show the efficiency of the gains to be in favor of the powdered milk-fed group, especially so in the case of the dry matter gain. The normal milk lot required 4.99 Calories for one gram of live weight gain and 17.82 for one gram of dry matter, and the corresponding figures for the powdered milk group were 4.93 and 15.87. This brand of powdered milk was 12.3 (17.82 ÷ 15.87) percent more efficient for growth (dry matter) than the normal milk.

TABLE 19.—GROWTH OF YOUNG PIGS

	Litter 1				
	Normal milk No. 47	Powdered milk No. 48	Normal milk No. 51	Powdered milk No. 49	Powdered milk No. 50
1. Initial weight, grams	1,182	1,135	1,087	987	1,062
2. Final weight, grams	2,884	3,321	4,125	4,462	4,741
3. Live weight gain, grams	1,702	2,186	3,038	3,475	3,679
4. Dry matter gain, grams	413	634	892	1,006	1,209
5. Days fed	17	17	25	25	25
6. Average daily gain, grams	100	129	122	139	147
7. Percentage gain	144	193	279	352	346
8. Calories fed	8,434	9,779	15,401	16,351	17,667
9. Calories per gram live weight gain	4.96	4.47	5.07	4.71	4.80
10. Calories per gram dry matter gain	20.42	15.42	17.27	16.25	14.61

TABLE 19.—GROWTH OF YOUNG PIGS—*Concluded*

Litter 2		Litter 3					
Powdered milk No. 54	Powdered milk No. 53	Normal milk No. 56	Powdered milk No. 57	Normal milk No. 58	Powdered milk No. 59	Normal milk No. 60	Powdered milk No. 61
1,031	1,265	1,777	1,882	1,673	1,758	1,655	1,510
3,740	4,255	3,837	4,523	4,808	5,577	6,501	6,980
2,709	2,990	2,060	2,641	3,135	3,819	4,846	5,470
799	841	561	807	820	1,201	1,447	1,877
28	28	19	19	24	24	31	31
97	107	108	139	131	159	156	176
263	236	116	140	187	217	293	362
15,158	15,571	10,685	13,170	15,110	18,143	24,050	27,085
5.60	5.21	5.19	4.99	4.82	4.75	4.96	4.95
18.97	18.51	19.05	16.32	18.43	15.11	16.62	14.43

TABLE 20.—GROWTH OF YOUNG PIGS

Average of litters 1, 2 and 3	Normal milk (average 5 pigs)	Powdered milk (average 8 pigs)
1. Initial weight, grams	1,475	1,329
2. Final weight, grams	4,431	4,700
3. Live weight gain, grams	2,956	3,371
4. Dry matter gain, grams	827	1,047
5. Days fed	23.2	24.6
6. Average daily gain, grams	127	137
7. Percentage gain	200	254
8. Calories fed	14,736	16,616
9. Calories per gram live weight gain	4.99	4.93
10. Calories per gram dry matter gain	17.82	15.87

TABLE 21.—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK NO. 2—CHEMICAL COMPOSITION OF CARCASSES

Pig number	Final weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
47	2,884	77.20	22.80	338.6	3.51	14.57	4.	15.37	63.90	17.56	3.64
51	4,125	72.93	27.07	269.4	3.09	15.	7.98	11.40	55.42	29.48	1.88
56	3,837	73.56	26.44	278.2	2.75	14.72	8.27	10.41	55.66	31.28	1.78
58	4,808	74.07	25.93	285.6	2.15	12.95	10.27	8.29	49.93	39.60	1.26
60	6,501	71.25	28.75	247.8	2.44	14.09	11.84	8.50	49.02	41.19	1.19
Average	4,431	73.35	26.65	275.2	2.69	14.18	9.14	10.10	53.22	34.31	1.55
				(Fed powdered milk)							
48	3,321	73.85	26.15	282.4	3.32	14.95	6.73	12.70	57.16	25.73	2.22
49	4,462	72.87	27.13	268.6	3.25	14.95	8.27	11.97	55.11	30.50	1.81
50	4,741	69.85	30.15	231.7	3.28	15.20	10.89	10.89	50.42	36.11	1.40
53	4,255	74.05	25.95	285.4	3.36	14.70	7.30	12.93	56.66	28.12	2.01
54	3,740	72.92	27.08	269.3	3.32	15.	7.71	12.24	55.39	28.45	1.95
57	4,523	71.55	28.45	251.5	3.08	15.81	9.03	10.84	55.56	31.75	1.75
59	5,577	70.43	29.57	238.2	2.87	15.38	10.75	9.71	52.01	36.36	1.43
61	6,980	67.60	32.40	208.6	2.98	16.08	13.06	9.18	49.63	40.31	1.23
Average	4,700	71.21	28.79	247.3	3.15	15.34	9.65	10.95	53.27	33.51	1.59

Physical condition.—The comments made on the physical condition of the two groups of pigs used in the preceding trial apply here. Both lots of pigs were equally thrifty and vigorous, well filled out and when slaughtered they could not be thus distinguished apart. Both lots were "off feed" at times but soon recovered when fed on skimmilk.

Composition of carcasses.—Tables 21 and 22, respectively, display the chemical composition of the entire bodies and of the gains. There was very little difference in the average amounts of fat and protein in the two groups, the respective ratios of fat to protein being 1:1.55 and 1.59, but the dry matter and ash were materially higher in the pigs fed

powdered milk, the dry matter averaging 8.0 and the ash 8.4 percent higher in the entire animal, the corresponding figures for the gains being 11.1 and 17.6.

The greater storage of dry matter by the pigs on powdered milk would indicate this milk powder to be superior to normal milk. This is in agreement with the results already given (table 20) wherein it was shown that less food Calories per unit of gain were required by the powdered milk-fed group.

The ratios of fat to protein of both lots of pigs by groups according to age are shown in table 23. The averages of the three groups are, respectively, for the normal, 1:2.33, 1.50 and 1.19, and for the powdered, 1:1.93, 1.52, and 1.57. These figures are in fairly close agreement in the first two groups but in the third group the lone normal milk-fed animal surpassed the others markedly, approaching very close to the 1:1.05 norm. These ratios are much narrower than those secured in the second trial but somewhat wider than those obtained in the first one. The fact that relatively rich milk was fed which would account for the increased fat storage over that made in the second trial, while the lesser amount fed might cause it to be less than that made in the first. However, this brand of powdered milk was superior in feeding value to that used in the former trial as measured by the efficiency of producing a unit of dry matter gain (tables 14 and 20) and proved to be equal to the evaporated milk fed in the first trial.

TABLE 22.—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK NO. 2—CHEMICAL COMPOSITION OF GAINS

Pig number	Weight of gain	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
47	1,702	75.74	24.26	312.2	2.71	16.07	5.68	11.16	66.24	23.42	2.83
51	3,038	70.66	29.34	240.8	2.52	15.93	10.27	8.60	54.29	34.99	1.55
56	2,060	72.75	27.25	267.	2.47	15.80	8.47	9.05	57.96	31.08	1.86
58	3,135	73.84	26.16	282.3	1.65	12.67	11.46	6.32	48.43	43.81	1.11
60	4,846	70.14	29.86	234.9	2.22	14.30	13.14	7.45	47.91	44.02	1.09
Average	2,956	72.04	27.96	257.6	2.25	14.70	10.68	8.06	52.59	38.21	1.38
				(Fed powdered milk)							
48	2,186	71.02	28.98	245.1	2.63	16.27	9.40	9.08	56.12	32.42	1.73
49	3,475	71.04	28.96	245.3	2.85	15.67	10.17	9.84	54.13	35.13	1.54
50	3,679	67.13	32.87	204.2	2.89	16.	13.57	8.79	48.69	41.28	1.18
53	2,990	71.87	28.13	255.5	3.22	15.30	9.32	11.46	54.40	33.12	1.64
54	2,709	70.52	29.48	239.2	3.18	15.66	9.68	10.79	53.11	32.83	1.62
57	2,641	69.44	30.56	227.2	3.09	17.47	9.74	10.10	57.19	31.88	1.79
59	3,819	68.55	31.45	218.	2.77	16.27	12.	8.82	51.72	38.16	1.36
61	5,470	65.69	34.31	191.5	2.95	16.80	14.45	8.58	48.97	42.11	1.16
Average	3,371	68.95	31.05	222.1	2.94	16.18	11.51	9.48	52.10	37.08	1.41

TABLE 23.—RELATIVE AMOUNTS OF FAT AND PROTEIN IN CARCASSES ACCORDING TO AGE

Milk	Group 1 17 to 19 days				Group 2 24 to 25 days				Group 3 28 to 31 days			
	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein
	No.	%	%	1:	No.	%	%	1:	No.	%	%	1:
Normal	47	63.9	17.6	3.63	51	55.4	29.5	1.88	60	49.	41.2	1.19
Normal	56	55.7	31.3	1.78	58	49.9	39.6	1.26				
	Ave.	59.2	25.4	2.33	Ave.	52.4	34.9	1.50	Ave.	49.	41.2	1.19
Powdered	48	57.2	25.7	2.23	49	55.1	30.5	1.81	53	56.7	28.1	2.02
No. 2	57	55.6	31.8	1.75	50	50.4	36.1	1.40	54	55.4	28.4	1.95
No. 2					59	52.	36.4	1.43	61	49.6	40.3	1.23
	Ave.	56.2	29.2	1.92	Ave.	52.4	34.5	1.52	Ave.	53.1	33.9	1.57

VII. NORMAL WHOLE MILK VS. REMADE MILK

The third trial compared normal cow's milk and remade milk. Five litters of 37 pigs were used, five, one from each litter, as checks, 14 on normal and 18 on remade milk. Two pigs, one from each group, died soon after being placed on trial for no apparent reason other than that they were weak at birth. The 30 healthy animals were fed from 16 to 38 days, totaling 769 pig-days.

Milks.—The remade milk was a mixture of unsalted butter 7¼ ounces, skimmilk powder 14 ounces and water 138¾ ounces, 10 pounds in all. The mixture was heated sufficiently to melt the butter and dissolve the powder and was then emulsified. A quantity sufficient for two days was made up at a time, kept iced and warmed as used. Ayrshire milk was used for the normal milk and was fresh each day. Each lot was analyzed, the average analyses being set forth below. They are closely identical.

TABLE 24.—AVERAGE COMPOSITION OF NORMAL AND REMADE MILKS

Milk	Water	Total solids	Ash	Protein	Milk sugar	Fat
	%	%	%	%	%	%
Normal	87.96	12.04	0.53	3.01	4.84	3.66
Remade	88.05	11.95	0.55	3.03	4.70	3.67

Growth.—Table 25 shows the growth data of each pig and table 26 summarizes the data obtained on all five litters (13 normal cows' milk, 17 on remade milk). The average initial weights were practically identical but the final weights favored the normal milk-fed group by

over 200 grams. Dry matter gains also followed this same relationship. The pigs on normal milk gained nine percent more in live weight and 11.5 percent more in dry matter than those on remade milk. Lines 6 and 7 afford further evidence of the greater growth made by the pigs fed normal milk. Slightly more Calories of food were consumed by this group but not enough more appreciably to affect the comparative rate of growth of the two lots. The greater gains made on normal milk were due to its greater efficiency as shown in lines 9 and 10. More Calories of food were used by the pigs on remade milk in making a unit of gain, both live weight and dry matter, than by their competitors. The normal milk-fed group required 5.01 Calories for one gram of live weight gain and 16.66 for one gram of dry matter, while the corresponding figures for the remade milk-fed lot were 5.41 and 18.41. The remade milk was 90.5 percent (16.66 ÷ 18.41) as efficient for growth (dry matter) as the normal milk.

Physical condition.—The physical condition of both lots was good at the end of the trials. Those fed remade milk were not quite as large as those fed normal milk but, nevertheless, were solid and vigorous pigs. However, they scoured more frequently and for longer periods than those on normal milk, a trouble which disappeared when skim-milk replaced their usual diet for a few feedings.

TABLE 25.—GROWTH OF YOUNG PIGS

		Litter 1			
		Normal milk	Remade milk	Normal milk	Remade milk
		No. 64	No. 65	No. 66	No. 67
1.	Initial weight, grams	1,354	1,528	1,380	1,365
2.	Final weight, grams	2,912	3,050	4,495	4,292
3.	Live weight gain, grams	1,558	1,522	3,115	2,927
4.	Dry matter gain, grams	443	432	920	883
5.	Days fed	24	24	35	35
6.	Average daily gain, grams	65	63	89	84
7.	Percentage gain	115	100	226	214
8.	Calories fed	10,480	11,040	19,400	18,330
9.	Calories per gram live weight gain	6.73	7.26	6.23	6.26
10.	Calories per gram dry matter gain	23.66	25.56	21.09	20.76

TABLE 25.—GROWTH OF YOUNG PIGS—*Continued*

	Litter 2							
	Normal milk No. 68	Remade milk No. 70	Normal milk No. 69	Remade milk No. 71	Normal milk No. 74	Remade milk No. 73	Remade milk No. 75	Remade milk No. 76
1. Initial weight, grams...	1,468	1,380	1,135	1,175	1,215	1,580	863	1,125
2. Final weight, grams...	3,149	2,870	2,407	2,601	3,636	4,938	3,282	4,215
3. Live weight gain, grams	1,681	1,490	1,272	1,426	2,421	3,358	2,419	3,090
4. Dry matter gain, grams.	475	424	363	424	690	1,085	670	817
5. Days fed	18	18	18	18	26	26	33	33
6. Average daily gain, grams	93	83	71	79	94	129	73	94
7. Percentage gain	115	108	112	121	199	213	280	275
8. Calories fed	8,358	7,635	6,656	7,105	12,205	15,915	12,695	15,340
9. Calories per gram live weight gain	4.97	5.12	5.23	4.98	5.04	4.74	5.25	4.96
10. Calories per gram dry matter gain	17.60	18.01	18.34	16.76	17.69	14.67	18.95	18.78

TABLE 25.—GROWTH OF YOUNG PIGS—*Continued*

	Litter 3				
	Normal milk No. 77	Remade milk No. 78	Normal milk No. 79	Remade milk No. 80	Remade milk No. 81
1. Initial weight, grams	1,655	1,690	1,435	1,540	1,265
2. Final weight, grams	3,936	3,630	5,170	4,862	4,035
3. Live weight gain, grams	2,281	1,940	3,735	3,322	2,770
4. Dry matter gain, grams	696	609	1,156	968	850
5. Days fed	17	17	27	27	27
6. Average daily gain, grams	134	114	138	123	103
7. Percentage gain	138	115	260	216	219
8. Calories fed	10,105	9,614	17,015	16,865	14,940
9. Calories per gram live weight gain	4.43	4.96	4.56	5.08	5.39
10. Calories per gram dry matter gain	14.52	15.79	14.72	17.42	17.58

TABLE 25.—GROWTH OF YOUNG PIGS—*Continued*

	Litter 4				
	Normal milk No. 83	Remade milk No. 84	Normal milk No. 85	Remade milk No. 86	Remade milk No. 87
1. Initial weight, grams	1,180	1,243	1,066	1,096	975
2. Final weight, grams	2,776	2,701	3,882	2,934	3,137
3. Live weight gain, grams	1,596	1,458	2,816	1,838	2,162
4. Dry matter gain, grams	478	412	781	469	678
5. Days fed	16	16	26	26	26
6. Average daily gain, grams	100	91	108	71	83
7. Percentage gain	135	117	264	168	222
8. Calories fed	7,382	7,515	12,925	11,355	11,530
9. Calories per gram live weight gain	4.63	5.15	4.59	6.18	5.33
10. Calories per gram dry matter gain	15.44	18.24	16.55	24.21	17.01

TABLE 25.—GROWTH OF YOUNG PIGS—*Concluded*

		Litter 5							
		Normal milk	Remade milk	Normal milk	Remade milk	Normal milk	Remade milk	Remade milk	Remad milk
		No. 89	No. 90	No. 91	No. 92	No. 93	No. 94	No. 95	No. 9(
1.	Initial weight, grams...	954	1,328	1,155	1,234	1,155	940	1,252	1,047
2.	Final weight, grams...	2,123	2,702	4,340	3,777	3,985	3,515	6,555	4,372
3.	Live weight gain, grams	1,169	1,374	3,185	2,543	2,830	2,575	5,303	3,325
4.	Dry matter gain, grams.	373	389	951	734	781	806	1,813	979
5.	Days fed	17	17	29	29	34	34	38	38
6.	Average daily gain, grams	69	81	110	88	83	76	140	88
7.	Percentage gain	123	103	276	206	245	274	424	318
8.	Calories fed	5,786	7,018	15,070	13,090	14,865	14,610	24,995	19,500
9.	Calories per gram live weight gain	4.95	5.11	4.73	5.15	5.25	5.67	4.71	5.86
10.	Calories per gram dry matter gain	15.51	18.04	15.85	17.83	19.03	18.13	13.79	19.92

TABLE 26.—GROWTH OF YOUNG PIGS

Average of litters 1, 2, 3, 4 and 5	Normal milk (average 13 pigs)	Remade milk (average 17 pigs)
1. Initial weight, grams.....	1,261	1,257
2. Final weight, grams	3,797	3,583
3. Live weight gain, grams.....	2,536	2,326
4. Dry matter gain, grams	763	684
5. Days fed	25.	26.1
6. Average daily gain, grams	101	89
7. Percentage gain	201	185
8. Calories fed	12,711	12,594
9. Calories per gram live weight gain.....	5.01	5.41
10. Calories per gram dry matter gain.....	16.66	18.41

Chemical Composition.—The chemical analyses of the carcasses of the pigs and of their gains are given in tables 27 and 28, respectively. They are much alike. Those fed normal milk averaged 1.4 percent higher in dry matter, 5.2 percent higher in fat and 1.4 percent lower in protein than the animals on remade milk. The analyses of the gains followed the same order, the respective percentages being 2.3, 5.2 and 2.3. It would appear from these analyses that remade milk was slightly inferior to the normal milk in the production of body gain.

TABLE 27.—NORMAL WHOLE MILK VS. REMADE MILK—CHEMICAL COMPOSITION OF CARCASSES

Pig number	Final weight	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
64	2,912	74.75	25.25	296.	3.24	16.06	5.55	12.84	63.61	21.96	2.90
66	4,495	72.90	27.10	269.	3.55	15.35	7.84	13.09	56.64	28.93	1.96
68	3,149	73.52	26.48	277.6	3.28	15.18	7.46	12.39	57.31	28.16	2.04
69	2,407	73.38	26.62	275.6	3.34	15.39	6.73	12.56	57.81	25.30	2.28
74	3,636	72.86	27.14	268.4	3.04	15.37	8.22	11.22	56.63	30.28	1.87
77	3,936	73.84	26.16	282.3	2.96	15.44	7.41	11.32	59.01	28.31	2.08
79	5,170	72.05	27.95	257.8	2.65	15.44	9.18	9.47	55.23	32.86	1.68
83	2,776	74.30	25.70	289.1	2.99	14.97	7.26	11.65	58.24	28.26	2.06
85	3,882	74.41	25.59	290.8	2.64	14.52	7.67	10.32	56.73	29.95	1.89
89	2,123	74.60	25.40	293.7	3.18	15.82	6.07	12.52	62.27	23.90	2.61
91	4,340	73.45	26.55	276.6	2.88	15.59	7.31	10.85	58.73	27.53	2.13
93	3,985	75.37	24.63	306.	2.96	15.30	5.78	12.02	62.11	23.48	2.65
95	6,555	69.02	30.98	222.8	2.81	15.58	12.24	9.08	50.30	39.51	1.27
Average	3,797	73.06	26.94	271.2	3.	15.38	8.01	11.14	57.09	29.73	1.92
				(Fed remade milk)							
65	3,050	75.	25.	300.	3.10	15.71	5.04	12.41	62.85	20.16	3.12
67	4,292	72.54	27.46	264.2	3.58	15.73	7.82	13.03	57.28	28.47	2.01
70	2,870	73.46	26.54	276.8	3.12	16.05	6.98	11.76	60.48	26.28	2.30
71	2,601	72.66	27.34	265.8	3.18	16.16	7.45	11.63	59.11	27.24	2.17
73	4,938	70.20	29.80	235.6	2.82	14.88	11.56	9.45	49.95	38.80	1.29
75	3,282	73.15	26.85	272.4	3.31	15.07	7.87	12.32	56.12	29.31	1.91
76	4,215	74.08	25.92	285.8	2.99	15.57	6.93	11.55	60.04	26.75	2.24
78	3,630	73.83	26.17	282.1	3.26	15.92	6.50	12.47	60.83	24.85	2.45
80	4,862	73.71	26.29	280.4	2.66	14.93	7.95	10.12	56.78	30.23	1.88
81	4,035	72.60	27.40	265.	2.85	15.21	8.65	10.39	55.52	31.56	1.76
84	2,701	75.57	24.43	309.3	2.98	14.29	6.59	12.20	58.48	26.97	2.17
86	2,934	76.55	23.45	326.4	3.07	14.23	5.62	13.08	60.66	23.96	2.53
87	3,137	72.18	27.82	259.4	3.09	15.58	8.74	11.09	56.02	31.40	1.78
90	2,702	77.04	22.96	335.5	3.02	14.20	5.01	13.17	61.84	21.82	2.83
92	3,777	74.88	25.12	298.1	3.31	15.83	5.44	13.19	63.02	21.65	2.91
94	3,515	72.41	27.59	262.4	3.44	15.95	7.52	12.48	57.82	27.26	2.12
96	4,372	73.43	26.57	276.4	3.16	15.04	8.10	11.90	56.60	30.49	1.86
Average	3,583	73.54	26.46	277.9	3.10	15.32	7.47	11.73	57.90	28.25	2.05

TABLE 28.—NORMAL WHOLE MILK VS. REMADE MILK—CHEMICAL COMPOSITION OF GAINS

Pig number	Weight of gain	Water	Dry matter	Parts water per 100 parts dry matter	Original basis			Dry matter basis			Ratio fat to protein
					Ash	Protein	Fat	Ash	Protein	Fat	
	grams	%	%		%	%	%	%	%	%	1:
				(Fed normal milk)							
64	1,558	71.60	28.40	252.1	3.09	18.45	6.94	10.89	64.97	24.43	2.66
66	3,115	70.47	29.53	238.6	3.61	16.25	9.57	12.22	55.03	32.41	1.70
68	1,681	71.75	28.25	254.	2.90	16.78	8.52	10.28	59.40	30.17	1.97
69	1,272	71.47	28.53	250.5	3.01	17.21	7.18	10.55	60.32	25.16	2.40
74	2,421	71.52	28.48	251.1	2.71	16.39	9.21	9.51	57.54	32.34	1.78
77	2,281	69.50	30.50	227.9	2.36	16.62	11.78	7.73	54.48	38.61	1.41
79	3,735	69.06	30.94	223.2	2.21	16.06	12.18	7.13	51.92	39.36	1.32
83	1,596	70.07	29.93	234.1	2.71	16.51	11.10	9.04	55.16	37.07	1.49
85	2,816	72.28	27.72	260.8	2.36	15.13	9.78	8.52	54.60	35.29	1.55
89	1,169	68.08	31.92	213.3	3.01	18.85	9.86	9.43	59.07	30.90	1.91
91	3,185	70.14	29.86	234.9	2.70	16.86	9.44	9.03	56.46	31.63	1.79
93	2,830	72.42	27.58	262.6	2.79	16.61	7.57	10.11	60.22	27.43	2.20
95	5,303	65.82	34.18	192.6	2.68	16.40	14.80	7.83	47.99	43.28	1.11
Average	2,536	69.92	30.08	232.4	2.73	16.55	10.48	9.09	55.03	34.84	1.58
				(Fed remade milk)							
65	1,522	71.61	28.39	252.2	2.79	18.12	6.14	9.81	63.83	21.64	2.95
67	2,927	69.83	30.17	231.4	3.66	16.85	9.62	12.12	55.85	31.90	1.75
70	1,490	71.52	28.48	251.1	2.58	18.56	7.66	9.05	65.19	26.91	2.42
71	1,426	70.28	29.72	237.	2.74	18.49	8.44	9.23	62.22	28.41	2.19
73	3,358	67.70	32.30	209.6	2.39	15.61	14.07	7.40	48.31	43.54	1.11
75	2,419	72.30	27.70	261.	3.17	15.68	8.45	11.43	56.60	30.52	1.85
76	3,090	73.55	26.45	278.1	2.73	16.37	7.19	10.33	61.90	27.17	2.28
78	1,940	68.61	31.39	218.6	2.80	17.75	10.96	8.93	56.55	34.93	1.62
80	3,322	70.87	29.13	243.3	2.14	15.45	10.69	7.34	53.04	36.69	1.45
81	2,770	69.31	30.69	225.8	2.64	16.42	11.67	8.60	53.49	38.03	1.41
84	1,458	71.78	28.22	254.4	2.64	15.48	10.44	9.36	54.85	36.99	1.48
86	1,838	74.47	25.53	291.7	2.88	15.03	7.74	11.27	58.89	30.32	1.94
87	2,162	68.64	31.36	218.9	2.95	16.80	11.74	9.41	53.57	37.45	1.43
90	1,374	71.67	28.33	253.	2.67	16.24	8.48	9.43	57.32	29.93	1.92
92	2,543	71.14	28.86	246.5	3.28	17.64	7.38	11.36	61.14	25.59	2.39
94	2,575	68.70	31.30	219.5	3.46	17.36	9.75	11.05	55.45	31.14	1.78
96	3,325	70.55	29.45	239.6	3.09	15.97	10.20	10.49	54.21	34.65	1.56
Average	2,326	70.59	29.41	240.	2.87	16.55	9.74	9.75	56.29	33.13	1.70

The average ratios of fat to protein, 1:1.92 for the normal and 1:2.05 for the remade milk, indicate reduced increases in growth of fatty tissues as compared with previous trials. The average composition of these pigs, whether on normal or remade milk, deviated from that of the four to five weeks' old check pigs (table 2) more than was the case in the other trials.

Table 29, wherein the results are grouped according to the age of the pigs at slaughter, show wide ratios in all three divisions, 1:2.17, 1.99 and 1.72 for the normal and 1:2.37, 1.97 and 2.02 for the remade milk, indicating that the latter was less efficient than the former for growth of the animal body. The normal milk, as judged by the efficiency of dry matter production (table 26), compared favorably with the other normal milks fed, but the remade milk did no better than the powdered milk No. 1. This slow development was due to poor utilization of the milk fed.

TABLE 29.—RELATIVE AMOUNTS OF FAT AND PROTEIN IN CARCASSES ACCORDING TO AGE

Milk	Group 1 16 to 18 days				Group 2 24 to 29 days				Group 3 33 to 38 days			
	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein	Pig	Protein	Fat	Ratio fat to protein
	No.	%	%	1:	No.	%	%	1:	No.	%	%	1:
Normal	68	57.3	28.2	2.03	64	63.6	22.	2.89	66	56.6	28.9	1.96
	69	57.8	25.3	2.28	74	56.6	30.3	1.87	93	62.1	23.5	2.64
	77	59.	28.3	2.08	79	55.2	32.9	1.68	95	50.3	39.5	1.27
	83	58.2	28.3	2.06	85	56.7	30.	1.89				
	89	62.3	23.9	2.61	91	58.7	27.5	2.13				
	Ave.	58.8	27.1	2.17	Ave.	57.8	29.1	1.99	Ave.	55.3	32.1	1.72
Remade	70	60.5	26.3	2.30	65	62.9	20.2	3.11	67	57.3	28.5	2.01
	71	59.1	27.2	2.17	73	50.	38.8	1.29	75	56.1	29.3	1.91
	78	60.8	24.9	2.44	80	56.8	30.2	1.88	76	60.	26.8	2.24
	84	58.5	27.	2.17	81	55.5	31.6	1.76	94	57.8	27.3	2.12
	90	61.8	21.8	2.83	86	60.7	24.	2.53	96	56.6	30.5	1.86
					87	56.	31.4	1.78				
					92	63.	21.7	2.90				
	Ave.	60.2	25.4	2.37	Ave.	57.2	29.1	1.97	Ave.	57.6	28.5	2.02

VIII. DRY MATTER DEVELOPMENT

The dry matter content of the animal body is probably the most accurate measure of body development. A comparison of the percentage of dry matter in the two-day-old check pigs with that in the four- to five-weeks-old check pigs might be used as a norm showing optimum development. As has been stated, these older checks were fed entirely

upon sows' milk and their age corresponded to the maximum reached in the present trials. The average dry matter percentage in the baby checks was 21.5 (table 1) and in the older checks 33.4 (table 2), an increment of 55 percent.

Table 30 summarizes the gains made in the four trials by the pigs slaughtered at the approximate ages of two, of three and a half weeks and of five weeks, the second column showing the percentage increases in dry matter over that of the baby checks. The 55 percent norm was attained only once, the normal milk-fed pigs in trial 1, group 3. The evaporated milk-fed pigs gained 48 percent. In no other trial were such satisfactory increments secured. The relative growth rates of the animals fed the different milks is indicated by comparing the percentage increases in each group. Thus in trial 2 slow growth characterized the first and second but more rapid growth in third group. Conversely, in trial 3 the pigs fed powdered milk made a phenomenal growth in the first, continued rapid development during the second but evidenced very little increase in the third period. The pigs on remade milk started out well but the third group finished poorest of all the lots.

The last column affords a ready comparison of the food Calories used by the different lots per gram of dry matter gain. The most efficient growth was made by the pigs on normal milk in trial 1, requiring but 13.92 Calories for a unit of gain; those on evaporated and powdered milk were not far behind requiring, respectively, 15.85 and 15.87 Calories; while those on powdered milk No. 1 and the remade milk trailed.

TABLE 30.—DRY MATTER AND PERCENTAGE INCREASES AT END OF APPROXIMATELY TWO-, THREE AND ONE-HALF AND FIVE-WEEK FEEDING PERIODS

Trial number	Milk fed	Group 1, two weeks		Group 2, three and one-half weeks		Group 3, five weeks		Calories per gram gain of dry mater average of three groups
		Dry matter	Increase over check (2 days)	Dry matter	Increase over check (2 days)	Dry matter	Increase over check (2 days)	
		%	%	%	%	%	%	
1	Normal	26.8	25	30.	40	33.6	56	13.92
	Evaporated	26.5	23	28.9	34	31.8	48	15.85
2	Normal	24.3	13	26.5	23	28.2	31	17.43
	Powdered 1	24.3	13	24.6	14	27.8	29	18.46
3	Normal	24.9	16	26.5	23	28.8	34	17.82
	Powdered 2	27.5	28	29.	35	29.2	36	15.87
4	Normal	26.1	21	26.6	24	28.1	31	16.66
	Remade	25.5	19	26.7	24	26.9	25	18.41
Checks (2 days)		21.5						
Checks (4 to 5 weeks)		33.4	55					

IX. STOMACH CAPACITIES

Observations were made touching the capacities of the stomachs of these young pigs in order to note how they compared with the amounts of milk given at a feeding and to furnish a record for comparison with actual performance. Stomachs were removed at slaughter, emptied of their food contents, weighed and their capacities determined by cautiously filling with water, care being taken to avoid distention (tables 31 to 35).

The stomachs of the two-day-old check pigs (table 31) varied in weight from five to 12 grams, averaging 8.7 grams. No definite relationship obtained between live weight and stomatic weight. The smallest pigs (Nos. 1, 46 and 88) had the smallest stomachs, but on the other hand that of the largest pig (No. 63) was considerably smaller than that of a medium-sized pig (No. 28). Their capacities ranged from 15 to 50 c.c., averaging 29.8 c.c. Capacity did not seem to be coordinated with weight. The last column shows the ratios between stomatic weights and capacities, ranging from 1 : 1.5 to 5.6 and averaging 1 : 3.4. The natural inference is that wide ratios indicate thin walled and narrow ratios thick walled organs. Thus No. 63 would belong in the former and No. 23 in the latter class.

The data pertaining to the pigs fed the various grades of milk appear in tables 32 to 35. Weight and capacities of course increased as the pigs grew older. The stomachs of the normal milk-fed pigs averaged heavier and in all trials excepting one (table 34) averaged larger than those of the animals fed either the evaporated, powdered or remade milks. However, it will be remembered that the normal milk-fed pigs weighed on the average more than their rivals, making larger gains in all the trials excepting one (p. 23), wherein powdered milk No. 2 proved superior. Naturally larger and heavier pigs imply larger and heavier stomachs and vice versa.

The ratios of weight to capacity varied with the individual pigs and bore no apparent relationship to their respective size. They ranged from 1 : 2.3 (table 32) to 1 : 9.5 (table 35). In all the trials the averages were greater than that of the check pigs, indicating that as age advanced and growth increased, stomatic capacity also increased and decidedly more than stomatic weight, the average weight gain of 26 grams being accompanied by an average capacity gain of 157 cubic centimeters.

The next to the last column in the four tables shows the quantities of milk fed at a feeding at the beginning and end of the trials. The initial feedings always averaged more than the average capacity of the

stomachs of the check pigs. Apparently their stomach walls had to become somewhat distended in order to contain the quantities fed. On the other hand, by the end of the trials ample room was afforded for the amounts fed excepting, possibly, in the first trial (normal vs. evaporated milk—table 32), wherein approximately 25 percent more milk was given at a feeding than in the succeeding trials. It sometimes happened in this trial that the pigs did not take all the milk prescribed, but no adverse effects followed, for all these animals did exceptionally well.

It should be borne in mind that these data were obtained after the trials had been concluded and the pigs killed. Obviously they could not serve as a criterion therein but should be of use as a guide in the planning of further feeding trials along similar lines.

TABLE 31—CAPACITY OF STOMACHS OF CHECK PIGS (TWO DAYS' OLD)

Pig number	Weight of pig	Weight of stomach	Capacity of stomach	Ratio of weight of stomach to capacity
	grams	grams	c.c.	1:
1	708	6.5	20	3.1
2	997	10.	47	4.7
3	981	7.5	26	3.5
4	1,177	8.	35	4.4
3	1,052	10.	15	1.5
8	1,016	12.	23	1.9
9	1,024	7.5	19	2.5
4	1,271	10.	47	4.7
6	745	6.	18	3.
[illegible]	1,161	9.	25	2.8
	1,368	10.	24	2.4
	1,001	10.	26	2.6
	1,443	9.	50	5.6
	957	10.	43	4.3
	934	9.	37	4.1
	622	5.	22	4.4
	1,029	8.7	29.8	3.4

CAPACITY OF STOMACHS OF YOUNG PIGS—NORMAL WHOLE MILK VS. EVAPORATED MILK

Days fed	Initial weight	Final weight	Weight of stomach	Capacity of stomach	Ratio of weight of stomach to capacity	Milk fed per meal	Corresponding check pig number
	grams	grams	grams	c.c.	1:	c.c.	
			(Fed normal milk)				
14	1,172	2,903	24	79	3.3	50-145	1
12	1,161	2,835	23	98	4.3	31-112	2
13	1,495	3,465	30	145	4.8	43-141	13 & 14
[illegible]2	1,418	5,402	40	149	3.7	42-223	1
[illegible]	1,342	5,530	38	297	8.	36-220	2
	1,455	5,487	35	175	5.	41-190	13 & 14
	1,200	7,992	51	245	4.8	50-305	1
	1,281	8,430	55	250	4.5	36-295	13 & 14
	1,525	9,529	75	436	5.8	43-360	13 & 14
	1,339	5,730	41.1	208.2	5.1	41-221	
			(Fed evaporated milk)				
	1,022	2,401	20	46	2.3	28-112	1
	1,007	2,471	20	150	7.5	25- 92	2
	[illegible]1,402	3,204	29	137	4.7	36-116	13 & 14
	[illegible]1,230	4,506	31	130	4.2	35-174	1
	[illegible]275	4,536	34	241	7.1	31-137	2
	[illegible]244	4,665	30	138	4.6	33-150	13 & 14
	[illegible]18	6,894	45	126	2.8	36-212	1
	[illegible]0	8,065	50	195	3.9	40-245	13 & 14
		8,754	60	350	5.8	43-270	13 & 14
		5,055	35.4	168.1	4.7	34-168	

TABLE 33.—CAPACITY OF STOMACHS OF YOUNG PIGS—NORMAL WHOLE MILK VS. POWDERED WHOLE MILK No. 1

Pig number	Days fed	Initial weight	Final weight	Weight of stomach	Capacity of stomach	Ratio of weight of stomach to capacity	Milk fed per meal	Corresponding check pig number
		grams	grams	grams	c.c.	1:	c.c.	
				(Fed normal milk)				
33	18	1,400	2,764	22	135	6.1	42- 85	
38	19	1,432	3,436	30	195	6.5	42-115	
40	27	1,474	5,050	38	222	5.8	44-150	
26	34	1,339	5,222	35	144	4.1	29-165	
42	36	1,260	6,421	42	286	6.8	36-185	
44	42	965	5,880	44	239	5.4	30-165	
Average		1,312	4,796	35.2	203.4	5.8	37-14[illegible]	
				(Fed powdered milk)				
25	23	1,238	3,322	25	88	3.5	30-10[illegible]	
24	23	1,381	3,311	27	98	3.6	31-10[illegible]	
30	23	1,265	3,260	25	142	5.7	37-1[illegible]	
31	23	1,210	3,390	25	137	5.5	37-105	
32	18	1,189	2,560	20	83	4.2	36- 77	
39	19	1,495	3,625	30	142	4.7	45-100	
27	34	1,370	5,057	42	148	3.5	31-155	
41	27	1,437	5,126	39	247	6.3	42-135	
35	42	1,050	5,767	39	350	9.	30-165	
36	35	1,352	5,550	40	200	5.	40-165	
37	35	1,366	5,161	31	175	5.6	40-150	
43	36	1,325	6,619	47	300	6.4	40-185	
45	42	886	6,187	44	241	5.5	26-165	
Average		1,274	4,533	33.4	180.8	5.4	36-132	

TABLE 34.—CAPACITY OF STOMACHS OF YOUNG PIGS—NORMAL WHOLE MILK WHOLE MILK No. 2

Pig number	Days fed	Initial weight	Final weight	Weight of stomach	Capacity of stomach	Ratio of weight of stomach to capacity	Milk per [illegible]
		grams	grams	grams	c.c.	1:	c[illegible]
				(Fed normal milk)			
47	17	1,182	2,884	21	97	4.6	38[illegible]
56	19	1,777	3,837	44	200	4.5	54[illegible]
51	25	1,087	4,125	30	150	5.	35[illegible]
58	24	1,673	4,808	48	227	4.7	5[illegible]
60	31	1,655	6,501	51	272	5.3	5[illegible]
Average		1,475	4,431	38.8	189.2	4.9	
				(Fed powdered milk)			
57	19	1,882	4,523	35	179	5.1	
48	17	1,135	3,321	28	130	4.6	
53	28	1,265	4,255	30	188	6.3	
59	24	1,758	5,577	43	274	6.4	
49	25	987	4,462	30	186	6.2	
50	25	1,062	4,741	35	129	3.[illegible]	
54	28	1,031	3,740	29	174		
61	31	1,510	6,980	45	282		
Average		1,329	4,700	34.4	192.8		

TABLE 35.—CAPACITY OF STOMACHS OF YOUNG PIGS—NORMAL WHOLE MILK VS. REMADE MILK

Pig number	Days fed	Initial weight	Final weight	Weight of stomach	Capacity of stomach	Ratio of weight of stomach to capacity	Milk fed per meal	Corresponding check pig number
		grams	grams	grams	c.c.	1:	c.c.	
				(Fed normal milk)				
64	24	1,354	2,912	24	97	4.	45- 95	62
68	18	1,468	3,149	28	100	3.6	42- 95	63
69	18	1,135	2,407	20	121	6.1	33- 75	63
77	17	1,655	3,936	35	242	7.	50-120	72
83	16	1,180	2,776	24	194	8.1	35- 90	82
89	17	954	2,123	20	100	5.	30- 65	82
66	35	1,380	4,495	45	234	5.2	40-145	62
74	26	1,215	3,636	28	127	4.5	36-110	63
79	27	1,435	5,170	37	350	9.5	45-150	72
85	26	1,066	3,882	29	145	5.	35-100	82
91	29	1,155	4,340	30	192	6.4	30-130	88
93	34	1,155	3,985	27	128	4.7	30-100	88
95	38	1,252	6,555	45	310	6.9	30-225	88
Average		1,261	3,797	30.2	180.	6.	37-115	
				(Fed remade milk)				
65	24	1,528	3,050	25	92	3.7	45-105	62
70	18	1,380	2,870	25	98	3.9	42- 88	63
71	18	1,175	2,601	20	96	4.8	32- 82	63
78	17	1,690	3,630	27	181	6.7	45-110	72
84	16	1,243	2,701	24	150	6.3	38- 85	82
90	17	1,328	2,702	22	171	7.8	30- 75	82
67	35	1,365	4,292	37	134	3.6	40-135	62
73	26	1,580	4,938	36	246	6.8	45-150	63
80	27	1,540	4,862	39	343	8.8	45-145	72
81	27	1,265	4,035	34	289	8.5	40-130	72
86	26	1,096	2,934	25	170	6.8	33- 80	82
87	26	975	3,137	22	92	4.2	30- 85	82
92	29	1,234	3,777	30	147	4.9	30-120	88
75	33	863	3,282	25	97	3.9	28- 90	72
76	33	1,125	4,215	33	187	5.7	33-115	72
94	34	940	3,515	30	177	5.9	30-120	88
96	38	1,047	4,372	35	225	6.4	30-140	88
Average		1,257	3,583	28.8	170.3	5.9	36-109	

SUMMARY

The relative values of normal cow's milk, evaporated milk, powdered milks, and remade milk in infant feeding were studied in trials using baby pigs. Feeding began at two days after birth and continued until the pigs were from two to five weeks of age. These periods were intended to cover the growth of the pigs at various stages, from birth to normal weaning time. The feeding values of various milks when fed to older pigs (five weeks or more) were covered exhaustively in a previous work (12).

These four kinds of milks were successfully fed to the baby pigs. Comparisons, based on the vigor of the animals while on trial, on

total gains, on the amount and economy of dry matter gain and on the body composition, show that the normal milk which was used as the base of all the trials proved best, the evaporated milk and powdered milk No. 2 second best while remade and powdered milks No. 1 were somewhat less serviceable.

Compared with pigs on sow's milk, favorable dry matter gains were made on normal, evaporated and powdered milk No. 2, less favorable gains on powdered No. 1 and least favorable gains on remade milk. In economy of dry matter gains the normal milk ranked first followed closely by the evaporated and powdered milk No. 2 and less closely by the powdered No. 1 and remade milks.

Marked changes in body composition occurred coincident with increased age. Baby pigs at birth contain about 80 percent water, protein comprises the greater part of their dry matter content averaging over 60 percent, while their ash and fat contents each average 17 percent, the fat to protein ratio being about 1:3.6. As age advances the dry matter and fat percentages decidedly increase. In a well-developed pig at weaning age the dry matter percentage will be approximately 50 percent greater and of fat 150 percent greater than they are at birth, and the relative percentages of fat and protein will be nearly equal.

Stomach capacities of the check and experimental pigs were determined at slaughtering time. The data obtained indicate that, with the possible exception of some of the initial feedings, there was ample room for the quantities of milk given at a feeding.

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