THIRD EDITION

AND SUPPLEMENT TO

HISTORY

of

RANDLEIGH FARM

SECOND EDITION

LOCKPORT, NEW YORK

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CHAPTER XIV-C

Experiments in Nutritional Value of Milk

THIS RESEARCH WAS DONE AT RANDLEIGH FARM DURING THE WINTER OF 1939 BY MR. E. D. HILDRETH

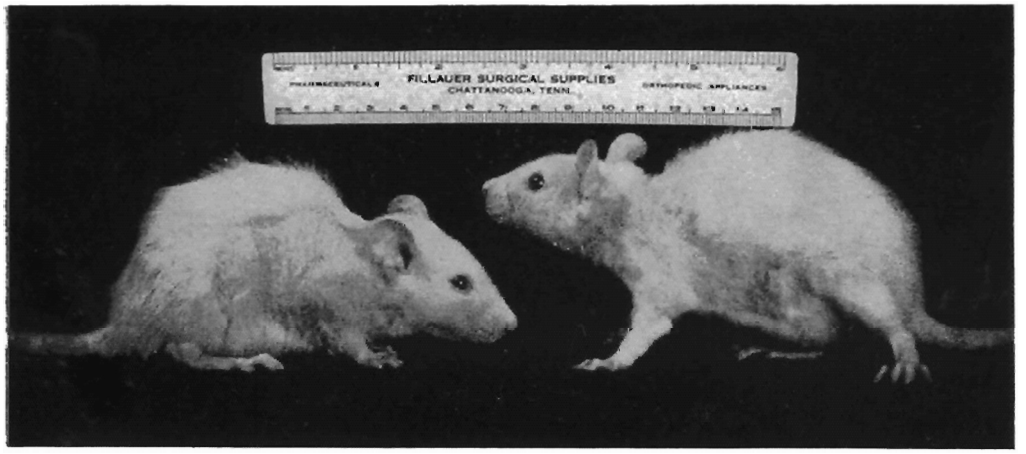
Introduction

The question of quality milk has long been discussed in research, clinics, and by the farm operators. Much speculation was offered as to the relative merits of various types of milks in nutrition. A large amount of work was done to single out those factors which are responsible for growth and maintenance of health.

The efforts of Randleigh Dairy Farm have been designated to improve the nutritional value of natural milk. With the research staff employed by Randleigh Farm, the efforts have been intensified to the problem of development of foodstuffs for high record milk and butterfat production for several successive official test periods, as well as problems of reproduction, and improvement of nutrition of milk produced by these cows. The work on quality milk is a continuation of that by Scott and Erf[1] in which they showed that milk is subjected to wide variation in its food value as affected by the type of food intake of the cow. Further evidence is supported by Luce[4], Cary and Meigs[5], and Price[10].

In 1918, Osborne and Mendel,[2,3] found milk to be comparatively poor in antineuritic properties and they also found milk not to be a good source of water-soluble vitamins. Chick and Roscoe[7] contend that the vitamin A value of milk is entirely dependent upon the diet of the cow. Skurnik and Stenberg[16] proved that milk and blood of cows fed on special food contained 1½-2 times as much vitamin A and carotene as those from cows fed straw. Krauss[9] contends that cow milk is a relatively poor source of vitamin C. Riddell and Whitnah[12] show that no significant increase in the vitamin C content of milk occurred when cows were transferred from good winter rations to pasture. Later, Whitnah and Riddell[14] explained that the "Season of the year, individuality and breed of cow, and stage of lactation appear to be most important factors causing variations in vitamin C content of fresh milk from well-fed cows." Sharp[13] shows that the vitamin C content of fresh milk is relatively constant throughout the year. However, Ferdinand[15] demonstrates that the vitamin C content of cow's milk is lower in spring than in winter. Cultrera and Bellini[17] proved

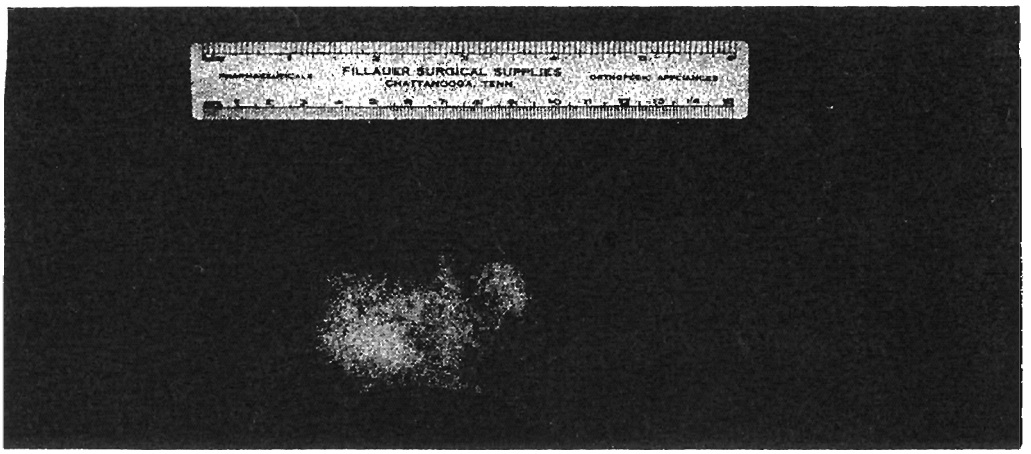
Rat fed only raw milk from cows fed dry ice grass silage and grain. Notice absence of acrodynia.



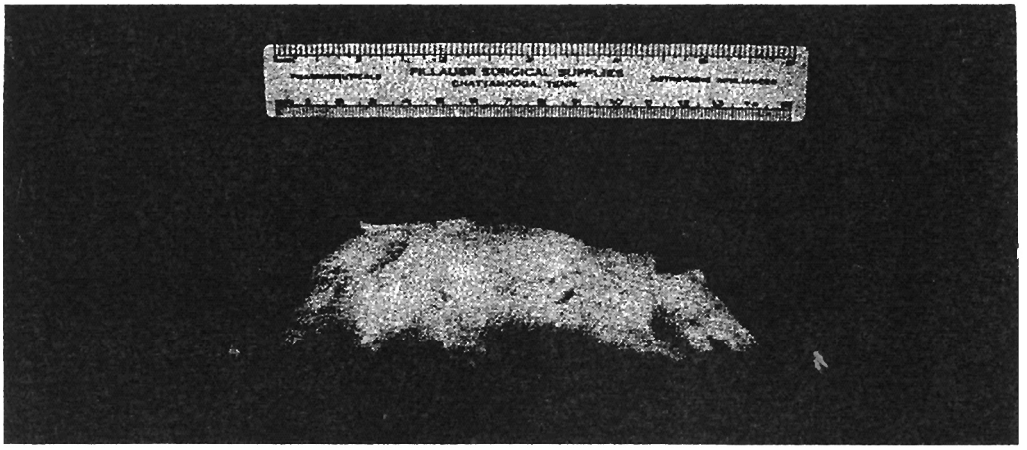
Rats fed only pasteurized milk from cows fed dry ice grass silage. Hairless areas (acrodynia) are due to a deficiency of vitamin B_6.

that the vitamin C content of cow's milk averages 25-30 mg. for one liter over the whole period of lactation, being greatest during March, April, and May; the average daily total being 280 mg. No direct relation could be found between types of feed and vitamin C secretion. Hunt and Krauss[11] contend that cows fed on early pasture during its vigorous state of growth produced a milk higher in vitamin G (B_2) than those fed on over-mature pasture, and that vitamin B (B_1) content of milk is much less affected by the state of pasture, but is slightly higher on fresh grass than on over-mature grass diet.

It is interesting to observe in the summary by Ladd *et al.*[6] that the use of certified raw milk without orange juice or cod liver oil produced a considerably greater gain in body weight in babies than



Rat fed on pasteurized milk from cows fed dry ice grass silage and grain. A striking example of a deficiency of riboflavin and other complex growth factors.



Rat fed mineral supplemented pasteurized milk from cows fed only dry ice grass silage. Condition of rat is due to a deficiency of thiamin, riboflavin, and other complex growth factors. This rat lived a week after picture was taken.

did pasteurized milk alone or in combination with orange juice and cod liver oil. Certified milk produced normal dentition and protected from rickets. Larger use of certified milk in infant feeding is advocated. Further interest along this is substantiated by Lewis[8] in which he used each type of milk in the diet of over 100 infants. Certified milk produced greater average gains in weight and growth and more freedom from rickets.

Experimental

In the selection of the five rats for each pen, the mean average weight was emphasized to not have much variation between the groups of the entire colony. Special attention was given to the construction

of the pens in which all exposed wire was carefully soldered, thereby eliminating all possibility of the experimental animals obtaining copper and iron from the pens. To further guard the possibility of contamination, distilled water was delivered into the pens by glass tubes from 250 cc. water bottles, attached outside of the pens. Special attention was further emphasized to thoroughly cleanse and sterilize the glass food receptacles before each administration of food.

To obtain the quickest measurement of response of the biological values of the various types of milks, we "devitalized" the entire colony for a period of about two weeks on the following formula:

20% of vitamin free casein
74% of starch
6% of olive oil
Distilled water ad lib.

The following table gives the comparison of the group weights (five rats per group) before and after the depletion period and also shows the average percentage of hemoglobin after the period of depletion:

		Weight in Grams		
		Before Depletion	*After Depletion*	*% of Hemoglobin (Sahli)*
1.	Normal growth ration	43.0	49.5	88.2
2.	Raw grass milk	42.8	42.4	85.0
3.	Raw grass and grain milk	43.8	44.1	94.8
4.	Raw herd milk	42.4	44.0	90.8
5.	Average farm raw milk	41.6	42.8	78.0
6.	Raw grass milk + mineral	42.0	45.0	88.2
7.	Raw herd milk + mineral	42.0	42.4	78.8
8.	Average farm raw milk + mineral	43.2	38.8	84.1
9.	Pasteurized grass milk	42.8	42.6	96.6
10.	Pasteurized grass and grain milk	34.0	42.6	82.1
11.	Pasteurized herd milk—Female	42.0	40.1	90.4
12.	Pasteurized market milk—Female	43.1	42.6	88.7
13.	Pasteurized grass milk—Female	44.0	39.8	94.8

In general, the average weights of the various groups were in close agreement. Group 10, designated as pasteurized grass and grain group, was the lightest, but, probably due to body reserve, gained considerably during the depletion period and averaged 42.6 grams at the beginning of the actual feeding experiment. The observations of weights and percentage of hemoglobin after the period of depletion are referred to as initial readings and the data are presented and constructed from these bases.

The data are presented in five charts: 1 the actual weights in grams; 2 percentage of deviation from initial weights or percent

increase in growth from the base; 3 straight line curve calculated by $y = mx + b$ from the data used in the chart showing the percentage of deviation; 4 the extreme in percent of deviation or the lowest percent of gain represented at the extreme left and the highest percent of gain as shown at the right; 5 the percent of hemoglobin for each group is plotted and scaled for the sixty days of the experiment. The readings were taken at two-week intervals and the initial reading is represented at the top of each curve. The hemoglobin determinations were conducted by Misses Marjorie Sprague and Louise Banks, technicians of the Lockport City Hospital. For the sake of clarity, the data and discussion of each group will be developed separately.

Raw Milk Groups

In the study of the raw milk groups, the male groups are considered. The primary object of this particular study was to measure the response of the various groups according to the raw milk diets they consumed. In the following outline, the food for the various groups is described.

Pen No. 1 or normal control group—fed normal growth ration.

Bill's Modification of the Steenbock Stock Diet[18]

Yellow corn	57
Dried whole milk	25
Linseed oil meal	12
Crude casein	3.7
Alfalfa leaf meal	1.5
Iodized table salt	0.4
Calcium carbonate	0.4

Pen No. 2 or raw grass milk*, received milk from three cows fed green alfalfa grass perserved in dry ice.

Pen No. 3 or raw grass and grain milk*, received milk from three cows fed alfalfa hay preserved by dry ice and in addition were given herd ration.

Pen No. 4 or raw herd milk*, received raw herd milk or milk obtained directly from the milking system at Randleigh Farm.

Pen No. 5 or average farm raw milk*. Milk for this group was obtained from a nearby farm that represented average dairy farm conditions. The ration consisted of commercial grain, corn ensilage, field cured hay, and brewers' grain.

*All of these milks were standardized for butterfat content.

There was a 1.4 gram average variation in the group weights before the depletion, and that difference was most marked between groups 1 (normal control group) and 5 (average farm raw milk). After the depletion and at the time the feeding experiment was begun, group 1 (normal growth ration) was the heaviest and represented a difference of 6.7 grams from group 5 (average farm raw milk); showed an average of 78% hemoglobin which we considered slightly low as compared with the average of other groups. In Chart 3, the actual percent of hemoglobin is plotted and in all cases except in the normal control group, the general trend of the readings was a sharp downward curve. In the raw grass group in sixty days, the hemoglobin dropped from 85% to 17%, this group showing the most severe anemias. However, the other three milk groups made a corresponding drop in percent of hemoglobin and the difference, comparatively speaking, is not significant. In the case of the normal control group, the hemoglobin dropped to 40% in one month's time after the depletion period, while on the normal diet, after thirty days, the rejuvenation was marked and the hemoglobin returned to 92% and by the end of the sixty-day period was 6% higher than at the beginning of the experiment. The percent of hemoglobin of the other four groups showed a very abrupt drop. The anemia of these groups proved to be very severe and did not show any signs of rejuvenation throughout the test period.

In the analysis of the weight charts, we find two distinct groupings. Referring to the Chart, we note that at the beginning and continuing for 15-18 days of the feeding trial, the groups showed a very similar growth curve. From this period on to the completion of the work, there were two distinct reactions. Groups 1 (normal growth ration), 3 (raw grass + grain milk) and 4 (raw herd milk) made parallel gains, while group 2 (raw grass milk) and 5 (average farm raw milk) showed a comparative loss. When this data is calculated in the percent of deviation from the initial weights, we still have in groups 1 (normal growth ration), 3 (raw grass + grain milk) and 4 (raw herd milk), a distinct gain over groups 2 (raw grass milk) and 5 (average farm raw milk). When this data is calculated on a straight line curve formula, $y = mx + b$, the trend of the group variations is clearly read. The most marked variation is shown in group 5 (average farm raw milk). In the Chart No. 2, the extremes of percent of deviation are interesting. The raw grass

and grain group made the outstanding gain in weight. The herd milk group was next, and both were superior to the normal controls. The raw grass group made the least gain and the average farm milk was second lowest.

Conclusion

1. The group of rats fed on Randleigh herd milk and the grass and grain group showed superior response after the depletion period.
2. The raw grass group and the average farm herd milk group showed an inferior growth gain.
3. Severe anemia occurred in all groups, showing the milk to be lacking in anti-anemic factors.