MILK and FOOD SANITATION

SANITIZATION OF DAIRY FARM UTENSILS. A COMPARISON OF A CLEANER-SANITIZER CONTAINING HYAMINE 1622 WITH AN ALKALINE CLEANER AND HYPOCLORITE SANITIZER

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On the basis of total and thermoduric plate counts of milk, sixty producers were divided into two groups of equal sanitary level. One group was supplied a standard cleaner and hypochlorite sanitizer. The other was given a detergent-sanitizer containing Hyamine 1622 and Triton X-100. The detergent-sanitizer group showed greater quality improvement, especially on lower grade farms. Appearance of utensils, farmer's comments, and laboratory studies indicate that these results were due to the superior detersive and germicidal properties of the detergent-sanitizer.

INTRODUCTION

THE problem of thermoduric organisms in milk has received increased attention during the past few years because of the use of the new standard agar which is more conducive to the growth of these bacteria and thus to their detection, and to the increasing use of high-temperature short-time pasteurizing units which allow the survival of greater numbers of the thermoduric micrococci. It is generally agreed that unclean dairy farm equipment is the principal habitat of thermodurics and that proper cleansing and sanitizing of equipment is necessary for the production of high quality milk.

A number of workers have demonstrated the susceptibility of thermodurics to quaternary ammonium germicides. Jensen and co-workers found that 0.5 percent lye and 200 ppm quaternary solutions had comparable germicidal activity.[6, 7] Quaternaries were more effective against thermodurics. Mallmann obtained poor results with a detergent-sanitizer, using a different procedure and composition than herein described.[8]

Hucker studied the detersive and germicidal efficiencies of cleaner-sanitizer compositions containing quaternaries, non-ionic wetting agents, and other detergents.[5] Such combinations were found to be particularly effective against thermoduric organisms. Use of cleaner-sanitizers on a number of farms maintained milking machines in a sanitary condition with consequent production of high quality milk.

No conclusions or recommendations were developed from a large scale study reported by Meany.[9] Barber has presented data showing the performance of several detergent-sanitizers.[2] Proper formulation was found to be a most important factor.

LABORATORY AND PRELIMINARY FARM TRIALS

A laboratory test procedure for determining the combined effect of germicidal and detergent activity has been developed by Goetchius and Botwright.[4] This method, which simulates farm conditions, was used to evaluate a number of liquid and powdered preparations containing a quaternary ammonium compound (Hyamine * 1622), and a non-ionic wetting agent (Triton ** X-100). Due to solubility limitations it was not possible to incorporate more than 30 percent active material in the liquids. Consequently, these preparations were less effective detergents. The most effective liquid containing 10 percent sodium metasilicate pentahydrate, and 70 percent water performed well in laboratory tests and on dairy farms, but was inferior to most powdered cleaner-sanitizers. These findings generally agree with those of Dahlberg and co-workers who found that neutral liquid preparations were inferior to alkaline powdered preparations.[3]

During a preliminary farm trial three powdered detergent-sanitizers were compared with a standard cleaner and hypochlorite sanitizer which were used according to the customary procedure. The equipment on the detergent-sanitizer schedule was rinsed in lukewarm water immediately following morning milking. The milking machine was disassembled, brushed in the detergent-sanitizer solution, and allowed to dry without rinsing. Immediately prior to milking, all equipment was rinsed with hot water. At night milking, a flush wash was substituted for disassembling and brushing.

Prior to each milking a sterile buffer solution containing both chlorine and quaternary inactivators was drawn through each machine. Total and thermoduric counts of the rinse solutions showed one composition to be particularly outstanding.

Hyamine 1622 crystals	10%
Triton X-100	5%
Sodium metasilicate pentahydrate	30%
Tetrasodium pyrophosphate	55%

This is a white, free-flowing powder which has a pH of 10.5 at the 0.2 percent use solution concentration. This has been proven to be non-irritating to the udder and teats of the cow, and to the hands of the operators engaged in its use.

It may be noted that Hucker and others have reported that sodium metasilicate is generally incompatible with quaternaries. However, we have found that certain proportions of this salt enhance the germicidal activity of Hyamine 1622, and thus advantage may be taken of its excellent detergent properties.

Received B.S. degree in biochemistry from Michigan State College in 1938. One year of graduate training was mainly devoted to food technology and a study of chlorine germicides. Engaged for the past twelve years in the research, development, and application of germicides in medical, industrial, and food sanitation fields.

* Di-isobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride, monohydrate.

** Alkyl aryl polyether alcohol. Trade-Marks of Rohm & Haas Company.

FIELD TRIAL

A field trial was then conducted in cooperation with a large dairy company on farms shipping milk to two country receiving stations. At each of these two receiving stations 35 farms were selected which had a record of insanitary milk production, based on plate counts of laboratory pasteurized samples.

CONTROL PERIOD

Ten to twelve samples of each of 70 producers' milk were collected at the receiving station during a 15-day period. On arrival at the laboratory, a slide was made for direct microscopic examination and a plate count made of the raw milk and after laboratory pasteurization at 143° F for 30 minutes.[1] Thirty farms at each station were selected from those producing the poorest milk and divided into two groups of 15. The remaining farms were dropped from the experiment. An extra producer whose bacteria counts were extraordinarily high was included in the group receiving cleaner-sanitizer at one station in order to provide a more severe test for the new materials.

EXPERIMENTAL

Each farm was then visited. The purpose of the experiment was explained and the farmers' cooperation solicited. Facilities for milk production were noted and the milking machine, utensils, and cans examined. The long vacuum hoses were cleaned by soaking in detergent solution and brushing, as some workers have shown them to be a source of contamination. Supplies of the appropriate cleaning materials were provided and their use carefully explained.

Group I farms were asked to sanitize their equipment by prerinsing, brushing in detergent solution, rinsing, and storing dry. The machine and utensils were rinsed with hypochlorite solution prior to milking. Group II farms were requested to use cleaner-sanitizer #5 according to the procedure given on page 2.

For a period of 13 weeks, samples were collected twice weekly and bacteriologically analyzed as during the control period. During the third and fourth weeks of this experimental period, all farms were again visited to check on methods of use. Further calls were made only on those producers having high pasteurized counts. As this occurred more frequently in Group I (using cleaner and hypochlorite), these producers received more stimulus to clean utensils.

RESULTS

Tables 1 and 2 present the plate counts of raw and laboratory pasteurized milk samples averaged logarithmically and arithmetically for each group at each station during the control and experimental periods.

At station A both groups improved milk quality during the experimental period. At station B Group I produced milk of similar quality during the entire experiment. At both stations, farmers using cleaner-sanitizer #5 produced excellent milk. Pasteurized counts were much lower with those exceeding 5,000 being reduced to a minimum.

Pseudomonas type organisms were observed rather frequently during the trials of Dahlberg.[3] These organisms were not controlled by quaternary sanitizers or a near-neutral liquid cleaner-sanitizer. An alkaline cleaner-sanitizer (pH 10.5) containing Hyamine 1622 and Triton X-100 was superior in this respect. During the present study

TABLE 1

STATION "A" SUMMARY

	Group I		Group II	
	Total	Thermoduric	Total	Thermoduric
Average Counts — 15 Day Control Period				
Arithmetic	72,400	3,820	128,000	6,310
Logarithmic	21,500	815	35,900	1,020
Percent Over 5,000		17.2%		20.0%
Total No. Samples	161	157	171	165
Average Counts — 13 Weeks' Experimental Period				
	(Cleaner+Hypochlorite)		(Cleaner—Sanitizer #5)	
	Total	Thermoduric	Total	Thermoduric
Arithmetic	75,700	2,830	67,700	768
Logarithmic	20,600	661	17,900	221
Percent Over 5,000		11.1%		2.39%
Total No. Samples	387	398	411	419

The percentage of pasteurized counts exceeding 5,000 are included as an index to the proportion of the samples which would be classified as "poor" milk.

TABLE 2

STATION "B" SUMMARY

	Group I		Group II	
	Total	Thermoduric	Total	Thermoduric
Average Counts — 15 Day Control Period				
Arithmetic	265,000	3,490	120,000	4,130
Logarithmic	61,000	1,250	43,000	1,240
Percent Over 5,000		13.7%		18.4%
Total No. Samples	149	146	149	147
Average Counts — 13 Weeks' Experimental Period				
	(Cleaner+Hypochlorite)		(Cleaner—Sanitizer #5)	
	Total	Thermoduric	Total	Thermoduric
Arithmetic	115,000	7,000	65,700	714
Logarithmic	33,600	1,040	14,100	234
Percent Over 5,000		24.4%		1.61%
Total No. Samples	368	365	373	372

TABLE 3

PERCENT DISTRIBUTION OF THERMODURIC COUNTS BY RANGE

Station A

Range	Group I (Cleaner+Hypochlorite) Control period	Group I (Cleaner+Hypochlorite) Experimental period	Group II (Cleaner—Sanitizer #5) Control period	Group II (Cleaner—Sanitizer #5) Experimental period
0–100	9.6	11.16	11.50	29.52
101–10,000	74.7	81.40	71.10	69.70
Above 10,000	16.3	7.5	16.40	0.70

Station B

Range	Group I (Cleaner+Hypochlorite) Control period	Group I (Cleaner+Hypochlorite) Experimental period	Group II (Cleaner—Sanitizer #5) Control period	Group II (Cleaner—Sanitizer #5) Experimental period
0–100	4.1	12.9	4.8	26.9
101–10,000	89.2	72.6	83.4	70.3
Above 10,000	6.7	17.2	19.8	0.5

Pseudomonads were seen on only two plates. By the "rubber strip" evaluation technique cleaner-sanitizer #5 is the most effective experimental or commercial preparation tested to date by this laboratory against dairy strains of Pseudomonas.

Distribution of pasteurized counts is given in Table 3. These data demonstrate that the reduction in the average pasteurized counts of patrons using cleaner-sanitizer #5 has been due to the virtual elimination of counts exceeding 10,000. This is highly important because the quality of an entire supply can be significantly lowered by one poor producer.

INDIVIDUAL PRODUCERS

Tables 4 and 5 present the logarithmically averaged pasteurized counts of each patron during the control and experimental periods.

These data show that pasteurized counts of 84 percent of the producers using cleaner-sanitizer #5 decreased compared to 53 percent of those using the commercial cleaner and the hypochlorite sanitizer. This, togeter with data in Table 3 which show that pasteurized counts over 10,000 were virtually eliminated, demonstrates that the use of the cleaner-sanitizer #5 has the greatest effect on the lower grade producer, thus resulting in a milk supply of higher bacterial quality.

The logarithmically averaged plate counts for each group of producers are graphically presented in Figs. 1 and 2. There appears to be little relationship between the counts of raw and laboratory pasteurized samples. At each station, the pasteurized counts of the producers using cleaner and hypochlorite (Group I) show an upward trend which is marked by rather large daily variation. On the other hand, Group II (cleaner-sanitizer #5) pasteurized counts trend downward with lesser daily variation. Considering the pasteurized counts as an index of the sanitary condition of the milking machine and utensils, it may be concluded that the cleaner and hypochlorite, as used by the producers, are less effective than cleaner-sanitizer #5. It would appear that the combination material minimized human fallibility providing a method

TABLE 4

LOGARITHMICALLY AVERAGED THERMODURIC COUNTS OF INDIVIDUAL PRODUCER'S MILK STATION "A"

Group I (Cleaner+Hypochlorite) Producer No.	Control period	Experimental period	Group II (Cleaner—Sanitizer #5) Producer No.	Control period	Experimental period
2	13,000	3,160	5	8,000	94
25	440	439	7	940	746
57	8,000	656	9	730	713
61	620	440	15	1,400	658
62	1,100	2,740	19	1,300	133
117	370	665	24	380	132
122	2,800	4,010	42	26,000	535
125	4,100	556	46	220	109
133	470	318	51	230	311
138	1,400	357	56	180	127
162	240	432	63	210	101
168	140	106	106	4,300	107
181	280	1,020	137	19,000	86
199	270	406	142	550	927
200	200	516	157	1,600	233
			192	220	157

TABLE 5

LOGARITHMICALLY AVERAGED THERMODURIC COUNTS OF INDIVIDUAL PRODUCER'S MILK STATION "B"

Group I (Cleaner+Hypochlorite) Producer No.	Control period	Experimental period	Group II (Cleaner—Sanitizer #5) Producer No.	Control period	Experimental period
6	1,700	2,860	2	5,300	109
13	1,400	550	16	6,890	81
22	4,500	3,030	17	230	150
34	620	605	28	1,100	175
40	220	231	29	3,500	70
62	300	171	41	360	957
66	980	479	48	4,200	611
83	2,700	1,010	52	1,200	530
89	5,300	776	56	2,300	340
92	4,900	1,460	68	190	392
96	3,200	8,000	97	1,250	234
99	2,100	3,500	107	5,400	478
106	1,000	2,690	117	400	238
108	370	2,500	121	470	253
112	360	138	122	250	90

FIGURE 2

STATION B

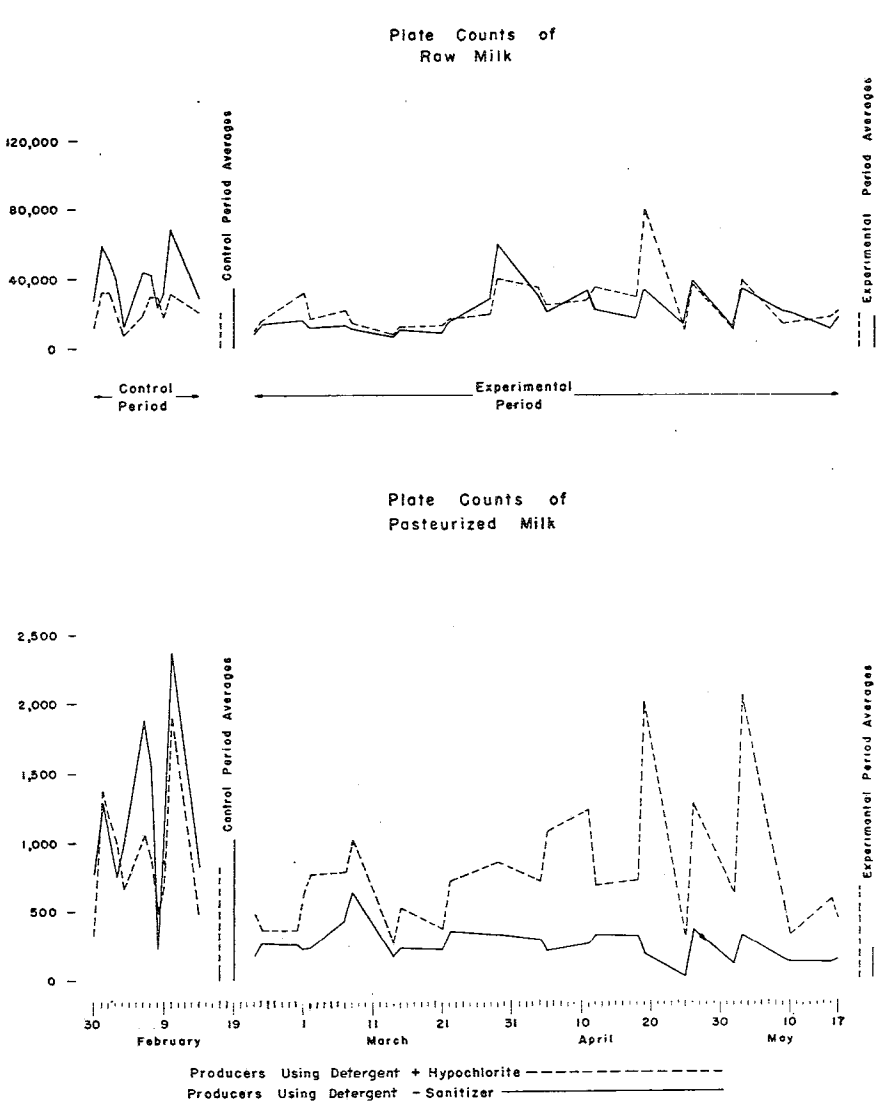
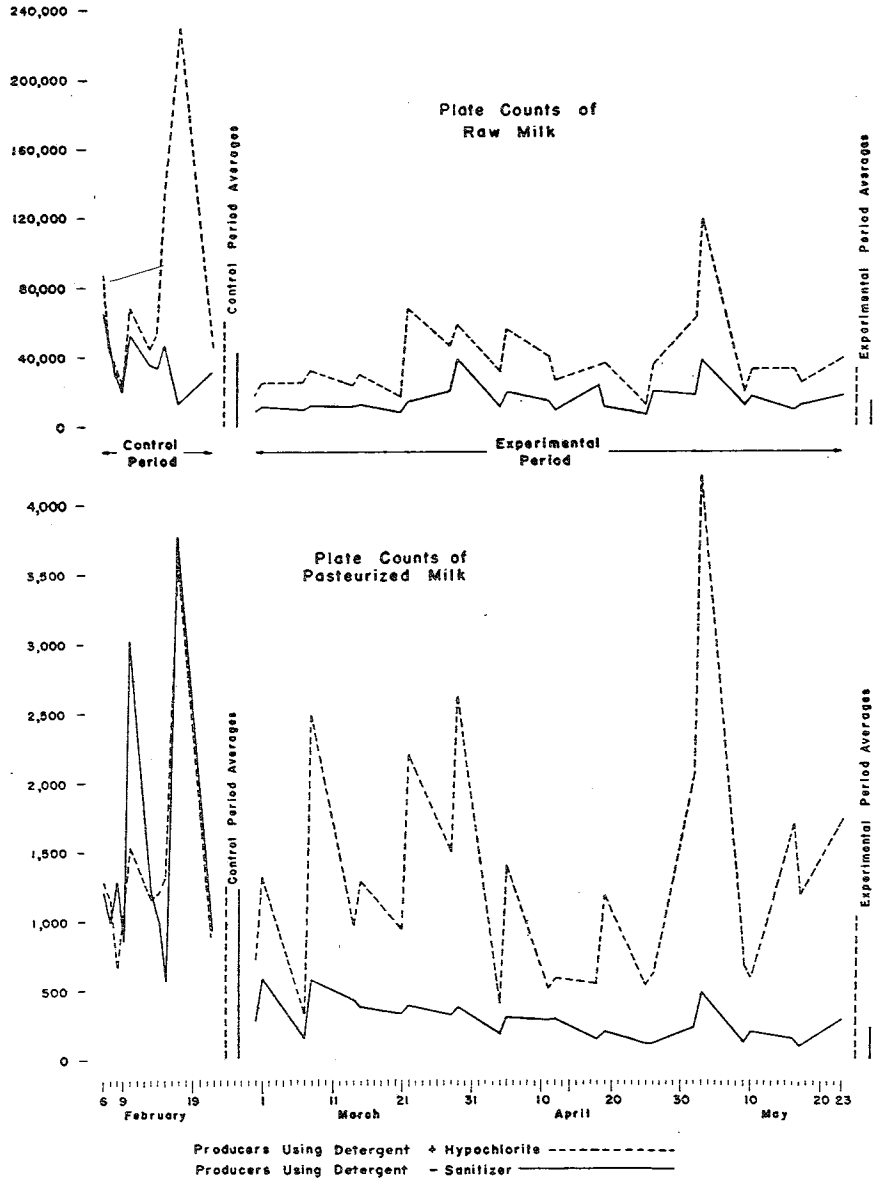


FIGURE 1

STATION A



whereby a less diligent person can more consistently maintain milking equipment in a clean and sanitary condition. Summarizing, farmers using cleaner-sanitizer #5 produced better quality milk more consistently than those using the standard cleaner and hypochlorite sanitizer.

The peaks in the total count graphs correlate approximately with the mean air temperature of the day preceding sampling. Mallmann observed that total counts were higher during warm weather.[8] Other workers have found that thermoduric counts were highest during winter months, which was attributed to lack of sufficient hot water for cleaning and to uncomfortable working conditions in the milk house.

The detersive efficiency of cleaners and germicidal activity of quaternary ammonium compounds are reduced by water hardness salts. This factor was investigated by determining the soap hardness of water used by each producer for cleaning utensils. At Station "A" this value ranged from 14 to 180 ppm (as calcium carbonate) and from 24 to 350 ppm at Station "B." In each case, the average hardness of water from farms using cleaner-sanitizer #5 exceeded that of water from farms using the cleaner and hypochlorite sanitizer. Hardness of water did not appear to affect adversely the quality of a producer's milk as measured by average pasteurized counts. In fact, producers having harder water tended to produce better quality milk.

DISCUSSION

The human factor is the weak link in the application of most sanitizing procedures to milking machines, resulting in unclean equipment and poor milk

Unsolicited comments from many producers using cleaner-sanitizer #5 during this trial, the amounts they used, and their purchase of the product after the termination of the experiment attest to its acceptability. Cleaning is paramount in any sanitization procedure as disinfection of unclean equipment is not only improper but exceedingly difficult. During this trial, patrons praised the virtues of #5 as a detergent, even claiming that it removed milkstone. There appeared to be some evidence to substantiate this. Old milk inflations often returned to their original size and shape, probably because of extraction of butter fat from the rubber. Good detergent characteristics coupled with high germicidal activity in the presence of milk solids are combined in cleaner-sanitizer #5.

Since the conclusion of the field trial, a number of dairies have made this cleaner-sanitizer available to their producers. Use has uniformly resulted in improvement of milk quality.

The success of these trials is due largely to the practical suggestions and cooperation of Messrs. Davenport, Harrison, Ricker, and Shepard of Supplee-Wills-Jones Milk Company. Laboratory facilities were graciously provided by Mr. Austin. Mrs. Copeland conducted the bacteriological analyses.

SUMMARY

Thirty-one farms using a cleaner-sanitizer composed of 10 percent Hyamine 1622, 5 percent Triton X-100, 30 percent sodium metasilicate pentahydrate, and 55 percent tetrasodium pyrophosphate produced milk with lower total and thermoduric counts than a comparable group using a standard cleaner and hypochlorite sanitizer.

REFERENCES

1. A.P.H.A. *Standard Methods for the Examination of Dairy Products.* 9th Ed. (1948).

2. Barber, F. W. Quaternary Ammonium Compounds in the Dairy Industry. *J. Milk and Food Technol.*, 13, 266 (1950).

3. Dahlberg, A. C., Kosikowsky, F. W., Seeley, H. W., and Leventhal, A. A. The Sanitizing of Milking Machines. *Ibid.*, 13, 5 (1950).

4. Goetchius, G. R., and Botwright, W. E. A New Method for the Evaluation of Quaternary Ammonium Detergent Sanitizer Compounds. *Ibid.*, 13, 63 (1950).

5. Hucker, G. J. Modified Non-Ionic Synthetic Detergents and Quaternary Ammonium Compounds as Cleaner-Sanitizers in Food and Dairy Operations. *N. Y. State Assoc. of Milk Sanitarians. 21st Ann. Rept.*, 35–51 (1947).

6. Jensen, J. M., and Bortree, A. L. Storage and Treatment of Milking Machine Inflations. *J. Dairy Sci.*, 29, 849–59 (1946).

7. Jensen, J. M., and Bortree, A. L. Storage and Treatment of Milking Machine Inflations Under Farm Conditions. *Ibid.*, 31, 331–39 (1948).

8. Mallmann, W. L., Kivela, E., Bortree, A. L., and Churchill, E. The Influence of the Method of Sanitizing Milking Machines on the Bacterial Content of Milk. *N. Y. State Association of Milk Sanitarians. 20th Ann. Rpt.*, 177 (1946).

9. Meany, J. A. The Chicago Test of Detergent-Sanitizers for Use on Dairy Farms. *J. Milk and Food Technol.*, 13, 279 (1950).

PURDUE WILL HOLD DAIRY CONFERENCES

Two one-day dairy conferences have been scheduled in March, 1952, at Purdue University. These conferences are as follows: Dairy Fieldmen's Conference, March 25 and Dairy Plant Operation Conference, March 26.

The conferences are a continuation of the series held annually for several years. Speakers consisting of specialists in the dairy industry and universities will discuss present day problems of fieldmen and dairy plant operators.

For further information write to: V. C. Manhart, Smith Hall, Purdue University, Lafayette, Indiana.

OREGON DAIRY MANUFACTURERS' ASSOCIATION

The 41st annual convention of the Oregon State Manufacturers' Association will be held at Oregon State College February 19-21, 1952.

The modern dairy building that has been under construction since May, 1950 will be completed by January 1st.

Speakers of national prominence will give talks and demonstrations on recent developments in several fields of the dairy industry. An attendance of 500 is expected. The annual banquet will be held during the evening of the last day.

21ST ANNUAL STATE COLLEGE OF WASHINGTON INSTITUTE OF DAIRYING

The 21st Annual Institute of Dairying will be held at the State College of Washington, Pullman, Washington, March 10-14, 1952. There will be Dairy Products Judging and Scoring Contests nationally known guest speakers will talk at this conference. For further information write Professor H. A. Bendixen, Department of Husbandry, State College of Washington, Pullman, Washington.