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THE CURVILINEARITY OF HERITABILITY OF BUTTERFAT PRODUCTION[1]

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The efficiency of selection of breeding animals is seriously limited because the phenotype of an economic quantitative characteristic is the result not only of genetic but also of environmental influences. The relative contribution of genetic and environmental influences is, therefore, information of significance.

Heritability is used as the measure of the portion of phenotypic variability which can be attributed to additive genetic deviations. The remaining portion of variability may be ascribed to environmental deviations and to any deviations resulting from dominance, over-dominance, epistasis, and non-linear interactions of heredity and environment.

A number of studies have shown that the heritability of most milk and butterfat records is of the order of 20 to 30 per cent (4, 5, 6, 7, 8). Carneiro and Lush (2) in a preliminary observation on Brazilian cattle of low average production and unusual genetic heterogeneity found heritability to be about 50 per cent. Studies with other animals have raised the question of whether or not heritability is a constant. Wright (12), studying the quantitative inheritance of piebald spotting in guinea pigs found that homozygosity, produced by inbreeding, reduced the portion of variation in spotting which was inherited. Later, Hetzer, *et al.* (3) found that heritability of type in swine was greater in crosses between divergent types than it was in matings within a type.

In the case of butterfat production of dairy cattle, one could speculate that either or both of the following situations would result in decreased estimates of heritability as production levels increased: (a) If high production is the result of homozygosity, lower genetic variance and heritability may be found at higher levels of production. (b) If high production is a consequence of dominance, over-dominance or epistasis, additive genetic variance and heritability may be smaller at higher levels.

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[1] The data published here are taken from a thesis presented by the senior author to the Faculty of the Graduate School, Cornell, University in partial fulfillment of the requirements for the Degree of Master of Science, June, 1948.

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The present paper gives the results of a study designed to test the assumption that heritability varies with level of butterfat production.

METHOD OF INVESTIGATION

The data were taken from "Proved-Sire Records" as issued by the Division of Dairy Herd Improvement Investigations, Bureau of Dairy Industry, U. S. Department of Agriculture. The present study is incidental to another and the data meet the specifications of the latter; therefore, each sire has a minimum of five daughter-dam comparisons in each of two or more herds. This fact could make the data atypical of DHIA data; however, the authors fail to see how this could influence greatly the problem under investigation. All individual butterfat records are the average, mature equivalent records for twice-a-day milking, 305-day-lactation periods. Table 1 presents a summary of the data used.

TABLE 1

Summary of the data from "Proved-Sire Records" used for the study of heritability

Breed	No. of sires	No. of herds	No. of daughter-dam comparisons
Holstein	120	271	2336
Jersey	32	66	544
Guernsey	24	53	427
Total	176	390	3307

The pooling of the variances of three breeds was justified first. The test of the homogeneity of variances, developed by Bartlett, was employed as described by Snedecor (10).

A multiple regression of daughters' butterfat production (Y) on dams' butterfat production (X) within breeds, sires and herds was computed for the purpose of estimating the curve of heritability. A fitted curve must be interpreted with caution, for it attempts to describe the situation only within the range of data studied; consequently, the extremes of the curve can be very misleading. The derivation of a curvilinear regression, however, does permit a statistical test of significance of curvilinearity. A modified polynomial curve was used to describe the regression.

A single coefficient cannot describe a curvilinear regression; therefore, heritability cannot be estimated by doubling a single regression coefficient as is the usual technique (4). Instead, it is necessary to estimate average linear regression coefficients at varying levels of butterfat production. These can be doubled to obtain indications of the heritability at various productive levels. Estimated daughters' production (Y) was computed from the multiple regression equation with dams' production (X) set at 100-lb. intervals. By setting X at 100-lb. intervals, the change in estimated Y over a 100-lb. interval of X becomes an estimate of the linear regression of Y on X at the midpoint of the interval considered.

RESULTS

Bartlett's test of the homogeneity of the three breed variances yielded a chi-

square value of 1.529 which falls between the 0.50 and 0.30 levels of probability. The statistical probabilities of real differences existing between the variances are low enough that the pooling of the variances was justified.

The equation of curvilinear regression of daughter's butterfat production on dam's butterfat production within breeds, within sires, and within herds, was was found to be as follows:

$$Y = 149.6 - 0.092\ X - 2.553\sqrt{X} + 47.03^{3}\sqrt{X}$$

$$R^2 = 0.018 \qquad R = 0.134$$

The linear regression of daughter's butterfat production on dam's butterfat production within breeds, within sires and within herds (b_{yx}) was found to be 0.137. The corresponding correlation coefficient is 0.127.

The test of significance of the curvilinearity of regression revealed that curvilinear regression does not differ significantly from linear regression. In view of the fact that curvilinearity approaches statistical significance and that the curve does fit the data more closely, calculations of curvilinear heritability were felt to be justified. However, it must be remembered that curvilinearity has not been definitely established and that more work is needed to prove or disprove its reality. A summary of this test is presented in table 2.

TABLE 2

Test of significance of curvilinearity of regression of daughters' butterfat production (Y) on dams' butterfat production (X)

Source of Variation	d.f.	S.S.E. $(1-r^2)Sy^2$	M.S.
Deviations from linear regression	2916	10,796,791.76	
Deviations from curvilinear regression	2914	10,777,796.64	3,698.63
Curvilinearity of regression	2	18,955.12	9,497.56
	F = 2.568 (not significant: 5% = 3.00)		

An estimate of average heritability of butter fat production may be obtained by doubling b_{yx}. It was found to be 27.4 per cent. The summary and results of the computations of curvilinear heritability of butterfat production are presented in table 3.

TABLE 3

The computation of the curvilinearity of heritability of butterfat production

Dam's production (X)	200	300	400	500	600
Estimated Y	370.1	392.6	408.3	419.8	428.3
Increase of $\hat{Y}$ over $\hat{Y}$ of next lower level of X		22.5	15.7	11.5	8.5
2 (increase of $\hat{Y}$) approximate av.% heritability		45.0	31.4	23.0	17.0
Av. level of X for the estimated % heritability		250	350	450	550

DISCUSSION

A comparison of the measurements of the curvilinear and linear relationships between daughters' butterfat production and dams' butterfat production with-

in breeds, within sires and within herds reveals that the multiple correlation coefficient ($R = 0.134$) is higher than the simple correlation coefficient ($r = 0.127$). The difference between linear and curvilinear regression, however, did not quite reach statistical significance at the 5 per cent level of probability. This is not evidence that the true regression is necessarily linear, for the curvilinear regression does fit the data more closely and, consequently, is the more probable one.

The genetic reasons for the observed trend of heritability as found in this study are not readily apparent. Two or more different effects may be at work. One possible explanation is that high production may be the result of homozygosity. In this case, as in that of Wright with spotting in guinea pigs (12), such genetic homozygosity would result in a smaller proportion of the observed variability of the characteristic being transmitted from generation to generation as the homozygosity increased. Results of inbreeding studies (1, 9, 11, 13) do not lend much support to this explanation. There is the possibility, however, that continued selection for high production may lead to homozygosity in some instances without the detrimental effects observed in most inbreeding experiments.

A second possible explanation, and there probably are others, is that high production may represent in many instances non-additive genetic deviations in addition to additive genetic influences. These non-additive genetic variations could be attributed to dominance, over-dominance, epistasis and gene-environmental actions. For all practical purposes, such effects are lumped with environmental deviations in the present methods of study and are not distinguishable from them. Also, from the standpoint of selection on the basis of individual performance these effects are non-transmissible.

It is impossible to determine which of these explanations is more probable or more important, though the second seems more likely. If the second is more important, the selection of breeding animals should be directed toward those individuals or families showing the desired phenotype in the progeny, and less emphasis should be placed on the performance of individuals.

SUMMARY

A statistical study of butterfat records of the progeny and mates of 176 proved sires of the Guernsey, Holstein-Friesian, and Jersey breeds has been made. Each bull was represented by at least five daughter-dam comparisons in each of two or more herds.

Curvilinear regression of daughter on dam within breeds, within sires and within herds accounted for a larger portion of the daughter variance than did linear regression. The difference, however, was not quite large enough to be statistically significant.

The heritability of butterfat yield calculated by doubling the linear regression of daughter on dam within breeds, within sires and within herds was 27.4 per cent. Estimates of heritability on the basis of curvilinear regression gave values decreasing with increased butterfat yield. The pattern described by these estimates appears to hold a valid relation to the problems faced by breeders

of dairy cattle and to the results of some experimental studies on similar problems.

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EXTRACTION AND ISOLATION OF GAMMA GLOBULIN FROM THE BOVINE THYMUS GLAND[1]

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The high mortality rate in young animals is a serious economic problem in the livestock industry in general and the dairy industry in particular. In addition to the use of improved methods of management, feeding and breeding, it is important to consider the inherent deficiency of the newborn animal as regards the immune globulin content of its blood. Nature overcomes this deficiency by providing the newborn animal with antibody-rich, immune lactoglobulin in its dam's colostrum. Furthermore, the immunity imparted through colostrum feeding is of a transitory nature and the young animal is more susceptible to diseases until such time as its own gamma globulin content of the blood attains a normal level. The possibility of overcoming this inherent deficiency by supplying the newborn animal with immune globulin in addition to colostrum feeding, either from the blood or from other tissues, seems feasible.

It was proved over half a century ago that specific antibodies to nursing mice were transmitted in the colostrum (6). Also, it has been demonstrated that placental transmission plays no important role in ruminants and that the transmission of immunity is mainly through colostrum feeding in newborn animals (8, 16, 18).

The blood serum of newborn calves is deficient in globulin and such animals, if not allowed to suckle, are unusually susceptible to colon bacillus septecemia (23). Furthermore, it has been shown by means of electrophoretic studies that the blood of a newborn calf lacks immune globulin and that an immediate increase in the gamma globulin content of the blood of newborn calves occurs following the ingestion of colostrum during the first 24 hr. (9, 12). The fact that in young animals the serum protein values are normally below adult values has a possible bearing upon the increased susceptibility of young calves to many infectious agents (4).

Numerous investigators have demonstrated that the lymph glands are sites of antibody formation (5, 13, 19). Many investigators also, have shown the similarity and inseparable nature of antibodies from immune globulin with which they are invariably associated (2, 4, 5, 22, 24).

Recent endocrine work indicated that lymph glands such as the thymus of small animals contained gamma globulin (25). The gamma globulin was thought to be released and regulated by the adrenal cortical hormones. It was thought that these tissues might serve as a rich source of gamma or immune globulin. Therefore, attempts were made to extract gamma globulin from the bovine thymi.

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[1] Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series no. 1172.

EXPERIMENTAL MATERIAL AND METHODS

Bovine thymus glands were obtained from the packing house immediately after slaughtering the animals. The glands were carefully dissected, fascia and fat being removed. These then were weighed into 50 g. lots, wrapped in butter paper and kept at – 15° C.

Acetone-dried and ether-defatted thymus tissue used in these experiments was prepared mainly according to the method described by Bergman and Turner (1) for the preparation of dehydrated pituitary powder except that the procedure was carried out at – 5° C. to avoid denaturation of the thymus tissue proteins.

Calf thymus dessicated at 40° C. used in these experiments was obtained from the Viobin Corporation, Monticello, Ill.

The procedure followed for the extraction of salt soluble proteins from the thymus glands was according to that described by Luck (17) for the extraction of proteins from liver. One molar NaCl solution was used to dissolve thymocytes and pH was adjusted to 5.0 with 0.05 *M* acetic acid to precipitate nucleoproteins, as recommended by Mirsky and Hans (20). Thymocytes also were extracted with a 20 per cent solution of NaCl according to the method described by White and Dougherty (35).

Mincing of the thymus tissue and stirring for extraction of the minced tissue was carried out in the cold, whereas centrifugation for the recovery of supernatant from the saline tissue extract was carried out at 3500 R.P.M. for one hr. at room temperature in the absence of a refrigerated centrifuge.

The general scheme followed for the separation of gamma globulin from the saline thymus extracts was according to the ethanol precipitation procedure described by Hess and Deutsch (11) for the serum of normal cows. The precipitation of gamma globulin from the saline thymus extracts also was attempted with ammonium sulfate, according to the procedure described by Cohn and coworkers (3) for the normal serum of the horse.

RESULTS

Only 60 mg. of acetone-dried gamma globulin was obtained from a 20 per cent saline extract of 50 g. of frozen bovine thymus by precipitating it at 34 per cent saturation with ammonium sulfate at pH 6.0. The ethanol precipitation procedure of Hess and Deutsch was ineffective in recovering gamma globulin.

DISCUSSION

It was not possible to extract and precipitate an appreciable quantity of gamma globulin from bovine thymus with either ethanol or salting-out procedures usually employed for blood. The negative results in these experiments may be explained as follows: First, there may be species differences. The hypothesis advanced by White and Dougherty (25) that the lymphoid tissues in small animals (rabbits and mice) are store houses of gamma globulin may not apply to large animals. Second, other investigators have failed to duplicate the results of White and Dougherty (25) in small animals. It has been shown that the level of serum albumin in the rat is under the control of the adrenal cortex (14). Also,

it has not been found possible to obtain evidence that adrenotrophic hormone causes a significant elevation in the concentration of the globulin fractions of the plasma or lymph of rats treated with adrenotrophic hormone (15). Furthermore, adrenal cortical activity in the rat is not essential for the fabrication or release of antibodies and gamma globulin (11). It also has been shown that adrenalectomized rabbits with hypertrophy of the lymphoid tissues produce antibodies far in excess of that produced by intact animals (21).

A very recent comparative electrophoretic and ultracentrifuge study has been made of the saline extracts of lymphocytes from popliteal (regional) lymph nodes of the hind feet of rabbits infected with killed dysentry organisms (10). The components with higher electrophoretic mobilities were increased after the injection of antigen, whereas the gamma globulin was not increased significantly.

The presence of a component of the same electrophoretic mobility as the gamma globulin of the blood in the lymphoid cells, as reported by White and Dougherty (25), also has been demonstrated by other investigators (10, 13). Therefore, there can be no question as to the presence of gamma globulin in the lymphoid cells, but these studies indicate that the amounts present in bovine thymi are not present in sufficient amounts to be extracted and precipitated by the procedures employed.

SUMMARY

1. Fresh bovine thymus glands, acetone-dried and ether-defatted thymus tissue, and desiccated calf thymus tissue were extracted with 1 *M* saline solution. No gamma globulin could be precipitated from these extracts either by adjusting the pH to 7.7 and ethanol concentration to 18 per cent by volume at $-10°$ C., or by ammonium sulphate at 34 per cent saturation at pH 6.

2. Fresh bovine thymus glands were washed three times with physiological saline and lysed with one volume of distilled water and then extracted with one volume of 20 per cent saline. The saline extract yielded 60 mg. of acetone-dried gamma globulin on 34 per cent saturation with ammonium sulphate at pH 6.

3. It is concluded that the bovine thymus, though containing small amounts of gamma globulin, cannot be used as a rich source of immune globulin.

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THE ISOLATION OF MALTOL[1] FROM HEATED SKIM MILK[2]

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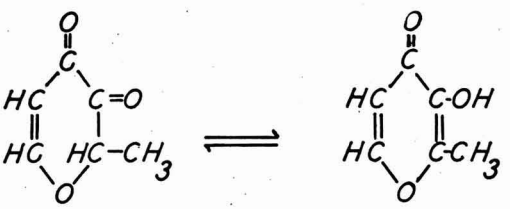
In an effort to clarify the nature of heat-induced chemical changes in milk and certain other dairy products, it has been the object of research in these laboratories to isolate and identify compounds produced in milk by heat. Previous studies have demonstrated the formation of furfuryl alcohol in skim milk as a result of heating (7). This paper reports the isolation and identification of maltol from heated skim milk and presents certain observations concerning its origin in this medium. The molecular constitution of maltol, which has been proven by Peratoner and Tamburello (8), is as follows:



EXPERIMENTAL

During the course of previous experiments (7), it was observed that distillation residues from the ether extract of heated skim milk gave rise to crystals on standing for a few days in the cold. Further, these crystals upon heating in vacuo would sublime from the residue. When this sublimed material was recrystallized several times from toluene, a pure crystalline compound (m.p. 159° C.) was obtained. This compound even in very high dilution gave an intense purple color with ferric chloride reagent. These preliminary observations served to characterize the compound for further research purposes.

Yields of the compound in these first experiments were extremely small (approximately 50 mg. from 20 gal. of heated skim milk). In order to improve the yield, several modifications of procedure were tried and the following one adopted for preparation of the compound: Five liters of condensed skim milk (29 per cent total solids) was autoclaved for 2.5 hr. at 127° C. The autoclaved milk was allowed to cool to room temperature. The whey was poured off and extracted three times with an equal volume of 80 per cent ether and 20 per cent

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[1] 3-hydroxy-2-methyl-pyrone-(4)

[2] Authorized for publication as paper no. 1548 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

methanol solvent mixture. The curd was broken up and washed three times using the above solvent. Final extraction of the curd was accomplished by allowing it to stand in the solvent overnight. The extracts of the whey and curd were combined and concentrated by evaporating the solvent on a steam bath. When the extract had been reduced to a volume of approximately 200 ml., it was dried over anhydrous sodium sulfate and the remnants of the solvent then removed on the steam bath. The extract residue was taken up in 50 ml. of hot toluene and the clear toluene layer decanted. On cooling, the toluene solution gave rise to a crude brown crystalline mass which on several recrystallizations from a mixture of toluene and ligroin yielded approximately 100 mg. of compound, m.p. 159° C. Six such experiments were required in order to obtain a sufficient quantity of the compound for identification purposes.

Characteristics of the compound from heated skim milk. In addition to the m.p. of 159° C., the property of sublimation, and the positive ferric chloride test, the following characteristics were observed for the compound: soluble in chloroform and alcohol; difficultly soluble in water, ether, benzene, and toluene; insoluble in petroleum ether and carbon tetrachloride; acid to litmus but ether-extractable and steam-distillable from 10 per cent sodium bicarbonate solution; did not give a satisfactory titration for neutralization equivalent; reacted with iodine, potassium iodide and sodium hydroxide to give iodoform; reduced neutral potassium permanganate, alkaline silver nitrate and Fehling's solution. The compound gave negative results with 2,4-dinitrophenylhydrazine, aniline and acetic acid, bromine in carbon tetrachloride and α-naphthol and concentrated sulfuric acid reagents.

Carbon and hydrogen analyses of the compound purified by several recrystallizations followed by sublimation gave 56.79 per cent carbon and 4.89 per cent hydrogen. Molecular weight of the compound (camphor melting point depression method) was determined as 128. These data calculated well to a molecular formula of $C_6H_6O_3$ for which carbon equals 57.14 per cent, hydrogen equals 4.80 per cent and molecular weight equals 126.

A search of the literature revealed that the properties of the compound isolated from heated skim milk were in good agreement with those compiled for maltol (1, 6).

Confirmation of identity. Of the three derivatives of maltol which are reported in the literature, namely, the methyl ether, benzoate ester and phenyl urethane, only the latter two are solids and, therefore, suitable for preparation in small quantities. Accordingly, the benzoate ester was prepared by the method of Feuerstein (4) and found to melt at 114–115° C. (given in the literature 114–115° C.). The phenyl urethane, prepared according to the method of Peratoner and Tamburello (8) melted at 151–152° C. (given in the literature 149–150° C.). As a final check, a mixed melting point was performed with the compound isolated from heated skim milk and a known sample of maltol donated by J. R. Schenck of the Abbott Research Laboratories. This sample of maltol was prepared from wood tar by the Cliffs Dow Chemical Co. (5). These two samples melted sharply at 159° C., both alone and mixed.

Origin of maltol in heated skim milk. In an attempt to determine the origin of maltol in heated skim milk two series of simplified systems were prepared. The first of these consisted of 7.5 per cent of purified casein (Arthur H. Thomas) together with 15 per cent of lactose, glucose or galactose (anhydrous, C.P. grade), respectively, made up in aqueous solution. Samples (750 g.) of the sugar-casein systems were autoclaved for 2.5 hr. at 127° C., cooled and extracted with ether-methanol mixture as previously described. The solvent-free extract residues were tested with ferric chloride reagent (3 per cent aqueous). That from lactose was positive while those of glucose and galactose were negative.

These findings suggested that the formation of maltol involved a lactose-casein interaction in which the intact lactose molecule was required. Since it is known that maltol can be produced by the pyrolysis of cellulose or starch alone (3), a catalytic role might be suggested for casein in this instance. To investigate this point further, a second series of simplified systems were prepared in which 3 per cent of glycine was substituted for the casein. The pH values of these systems were 7.0 ± 0.2. One kg. samples of the sugar-glycine systems were autoclaved for 6 hr. at 127° C. and cooled to room temperature. A slightly different method was used to concentrate the maltol. The autoclaved samples were saturated with sodium chloride and then steam distilled. The sodium chloride was found to facilitate the steam distillation of maltol considerably. The steam distillate from the lactose-glycine system gave a strong purple ferric chloride reaction. The reaction became gradually weaker and was negative after 5 l. of distillate had been collected. This distillate was extracted with an equal volume of chloroform which treatment effectively extracted the maltol from the distillate, as indicated by the ferric chloride test. The chloroform was evaporated off on a steam bath. The residue containing a small amount of chloroform was cooled in a refrigerator for several hours after which time crystals had appeared. Further crystallization was induced by the addition of a small quantity of petroleum ether. The crystals were filtered off, washed with cold ether, dried and weighed. A yield of 55 mg. of maltol, m.p. 158–159° C., was obtained from the lactose-glycine system. The steam distillates from the glucose and galactose systems, as well as that of a control lactose sample, were negative to the ferric chloride test. Since even a few milligrams of maltol dissolved in several liters of water will give a positive ferric chloride test, it seemed safe to conclude that the latter distillates contained no maltol.

DISCUSSION

Maltol is a rather obscure and somewhat unusual compound. It occurs in the bark of the larch tree (10) and in the needles of the silver fir tree (4). It also is formed during the roasting of malt (2), the dry distillation of cellulose and starch and the carbonization of wood (3, 5). Maltol also is formed by the degradation of streptomycin with alkali (9).

The isolation of maltol from heated skim milk may be of interest for several reasons. It seems clear from these studies that the compound has its origin in lactose and thus maltol represents one of the possible avenues of lactose degradation in heated milk. Further, although maltol can be formed from polysaccha-

rides, lactose, insofar as is known, is the first disaccharide demonstrated to serve as an origin. This may throw some light on the fundamental nature af maltol formation from carbohydrates. The fact that maltol could not be produced from either glucose or galactose in these experiments emphasizes the importance of the intact lactose molecule.

Based on the capacity of casein and the amino acid glycine to convert small quantities of lactose to maltol, a catalytic role may be indicated for the milk proteins in the formation of the compound in heated skim milk.

It appears unlikely that maltol occurs to any extent in heat processed dairy products unless they have undergone considerable browning as a result of rigorous heat treatment, prolonged storage or both. This matter will bear further investigation. It is known from previous experiments (7) that maltol is formed in skim milk heated for 90 min. at 127° C. How much this heat treatment may be reduced with detectable quantities of maltol being produced is not known. Steam distillation of the medium in question coupled with the ferric chloride test would be a very sensitive method of detection. It also is possible, as suggested by Schenck and Spielman (9), that the stable purple color, produced in the ferric chloride test, might lend itself well to colorimetric measurement, thus enabling quantitative measurement of maltol.

Samples of maltol from carbonized wood, streptomycin and heated milk all have a pleasant sweetish odor reminiscent of burnt sugar. This odor would appear to be characteristic of the compound, rather than one of contamination. In the quantities found in heated milk, maltol probably contributes little in the way of flavor or odor.

SUMMARY AND CONCLUSIONS

Maltol is one of the compounds formed in skim milk as a result of prolonged heat treatment at high temperatures. The amount of maltol produced in milk appears to increase with increasing concentration and heat treatment of the milk. The formation of this compound is correlated with browning of the milk and more specifically, depends upon the interaction of the milk proteins upon lactose. These experiments indicate that the complete lactose molecule is required, since maltol could not be produced from either glucose or galactose. A purified sample of casein and the amino acid glycine both were found capable of converting small quantities of lactose to maltol. A catalytic role seems possible for the proteins in the reactions by which maltol is formed in heated milk.

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construed as necessarily reflecting the views or endorsement of the Department of the Army.

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OCCURRENCE OF MICROCOCCI IN CHEDDAR CHEESE MADE FROM RAW AND FROM PASTEURIZED MILK[1]

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It long has been recognized that a desirable flavor develops more rapidly in cheddar cheese made from raw milk than in cheese from pasteurized milk. However, since more cheese of an inferior grade results from the use of raw milk, many cheesemakers sacrifice the added flavor development and use pasteurized milk to obtain cheese of a more uniform quality.

There have been numerous investigations of the bacterial flora of cheddar cheese made from raw milk in an effort to relate the organisms found to the ripening of the cheese. Hastings *et al.* (4) were among the first to show that streptococci were the predominant organisms in raw milk cheese during early ripening and were slowly supplanted by the lactobacilli. Other investigators (9) have found a similar development of streptococci and lactobacilli but none has been able to correlate the numbers of these organisms with the rate of ripening or the intensity of flavor development. Tittsler *et al.* (9) have shown that there are few lactobacilli present in cheese made from pasteurized milk.

Evans *et al.* (2) found micrococci in raw milk cheese but noted no correlation between the total numbers and flavor development. Rogers (8) suggested that the micrococci were present in sufficient numbers to be important in cheese ripening. Micrococci have been known for many years to be present in milk drawn aseptically from the udder (3). The chief argument against consideration of the micrococci as a factor in cheese ripening has been that they occur in such small numbers and disappear so rapidly that they would be of little or no importance. Rogers (8) stated that in any study of the bacteriology of cheddar cheese ripening it would be necessary to find cultures that would dominate the bacterial population. He believed it necessary to distinguish between those bacteria growing in the milk and those that grow in cheese in the curing room. Orla-Jensen (6) did not consider living bacteria essential to the ripening process. He believed that the enzymes released upon death and autolysis of the bacterial cells were most important.

This investigation was made to determine if any of the organisms found in raw milk cheese, other than the lactic acid bacteria, occurred in sufficient numbers to be of importance in the development of flavor in the cheese.

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EXPERIMENTAL PROCEDURE

The milk used for the comparison of the flora of raw milk cheese and pasteurized milk cheese was from the regular supply of the Dairy Industry Department of the University of Wisconsin. One half of the milk was pasteurized at 62.5° C. for 30 min., while the remainder served as the raw milk control. Cheese was manufactured in 450-lb. vats according to the usual methods (7).

The predominant bacteria in young cheese are the streptococci that originated from the starter. Other organisms are present in much smaller numbers and will be overgrown on any medium that permits normal growth of the lactics. It was necessary, therefore, to use a medium that would not support good growth of the lactics but would give well developed colonies of many non-lactic types. One per cent tryptone agar (tryptone, 10 g.; agar, 15 g.; water, 1000 ml.) was found to give the desired selectivity. Appropriate dilutions of 1-ml. samples of milk and 1-g. samples of curd and cheese were plated in the tryptone agar. Plates were incubated at 30° C. for 4 to 5 days before they were counted and colonies were isolated from them.

Petri dishes showing well isolated colonies were selected from each sample. All of the colonies from a representative section of the plates were picked and inoculated into semi-solid tryptone agar (0.3% agar). After incubation for 24 to 48 hr. at 30° C., the cultures were streaked on tryptone agar plates and these plates incubated at 30° C. for 48 hr. An isolated colony from each streak was picked into tryptone agar. This purification procedure was necessary to eliminate the microscopic colonies of lactic acid bacteria that often were carried over from the original tryptone agar plates. The cultures were divided into groups on the basis of morphology, pigmentation, action on litmus milk, proteolysis in milk agar, lipolysis in tributyrin and butterfat agar, growth in 6.5 per cent sodium chloride and growth at pH 5.2. These characteristics were selected rather than the usual ones used in differentiating bacterial species because they would give a better indication of the possible importance of the isolated organisms in cheese ripening.

To indicate further which organisms might be important in the ripening of cheese, sterilized milk was inoculated with 0.8 per cent of a *Streptococcus lactis* culture in milk and a similar number of micrococci from a selected micrococcus culture. Counts were made on these mixtures immediately and after 2 days of incubation at 30° C. to determine whether the micrococci were capable of multiplication in the presence of *S. lactis*.

The intensity of cheddar cheese flavor in the cheeses was recorded by use of a scale running from zero to four. The flavor intensities presented in the graphs are the averages of the intensities assigned by the different judges.

RESULTS

Sixteen pairs of cheeses were made to compare raw milk cheese with that made from pasteurized milk in regard to non-lactic flora and the rate of flavor development. Tryptone agar counts were made on the milk after addition of the starter, on the cheese at pressing and periodically during the ripening. All cheeses were

ripened at 5 to 7° C. The results obtained on paired raw and pasteurized milk cheeses are given in figure 1.

It is apparent that organisms other than lactic acid bacteria were present in raw milk cheeses in numbers ranging from 600,000 to 10,000,000 per g. by the time the cheeses were 1 day old. The non-lactics in cheese made from the same milk that had been pasteurized rarely exceeded 10,000 per g. Although the maximum number of non-lactics in raw milk cheese varied considerably, the counts on cheeses made from pasteurized milk were very close to one another. This suggests that the organisms that survived pasteurization multiplied at about the same rate, whereas those in raw milk cheese varied widely in the

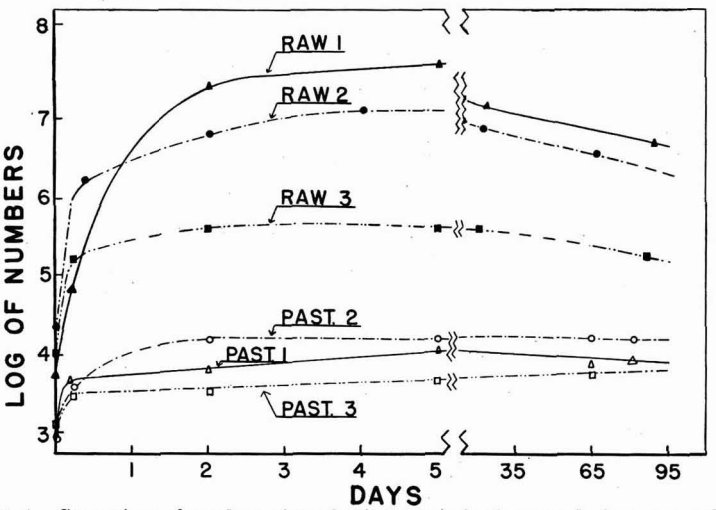

FIG. 1. Comparison of numbers of non-lactic bacteria in cheese made from raw and from pasteurized milk.

amount of their growth. There is a five- to eight-fold increase in the number of cells in curd as a result of the removal of the whey, and most of the apparent multiplication of non-lactics in the pasteurized milk cheese can be accounted for on the basis of this concentration. However, the number of non-lactics in the cheese from raw milk greatly exceeds the count that can be attributed to this cause. Most of the increase in count occurred during manufacture and while the cheese was still in the press.

Figure 2 contains a comparison of the flavor development in cheese made from raw and from pasteurized milk. This method of presentation of data is used because the rate as well as the amount of flavor development can be presented. The development of flavor was more rapid during the first few months in the cheese made from raw milk than in the companion cheese for which the milk had been pasteurized. Further increases in flavor, however, proceeded at about the same rate in the raw and in the pasteurized milk cheese. For example, a flavor intensity of 2 developed in 5 mo. in raw milk cheese no. 2, whereas a

flavor intensity of 1 had developed in that time in pasteurized milk cheese no. 2. At the end of the next 3-mo. period, however, both cheeses had increased in flavor intensity to 3. Similar relationships are evident in the other paired lots, al-

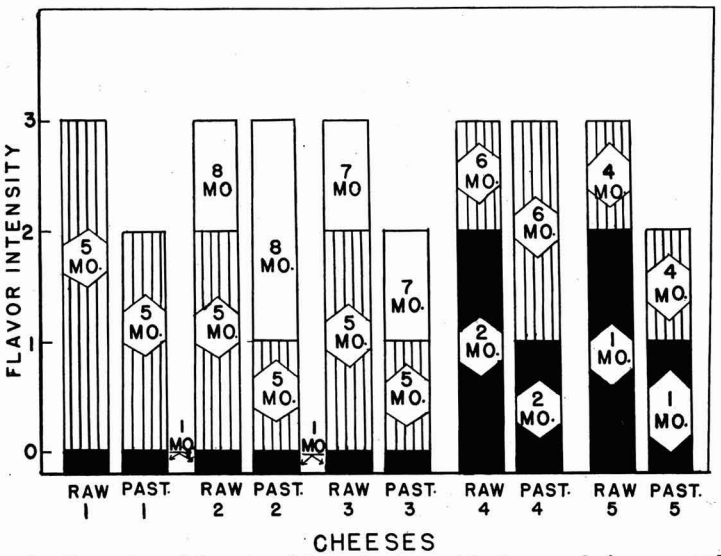

FIG. 2. Comparison of the rates of flavor development in cheese made from raw and from pasteurized milk.

though in some of them the pasteurized milk cheese did not develop as much flavor as the companion raw milk cheese developed during the course of the experiment. It was not possible to correlate the rate of development of flavor or the amount of flavor in the raw milk cheeses with the total number of non-lactic bacteria.

TABLE 1

Characteristics of representative cultures of micrococci isolated from raw milk cheese

Characteristic	Group no.					
	1	2	3	4	5	6
Litmus milk*	a, r, c, s	a, r, c	p	sl. a	a, r, c, s	n to a, r, c, p
Pigment**	W	W	W	W	W	Y
Tributyrin lipolysis	+	+	+	–	–	+
Butterfat lipolysis	–	+	–	–	–	– to +
Proteolysis (milk agar)	–	–	+	–	+	+
Growth at pH 5.2	+	+	– to sl.	–	+	– to sl.
Survival of pasteurization	var.	–	–	–	–	+

* a = acid
r = reduced
c = coagulated
p = peptonized
n = no change
s = shrunken curd

** W = white
Y = yellow or buff-colored

Over 600 cultures were isolated from the tryptone agar plates from the raw milk cheeses. Six groups of micrococci were isolated on the basis of the characteristics selected as indicative of importance in cheese ripening. These groups accounted for 78 per cent of the colonies that were picked; the remaining 22 per cent were coliforms and miscellaneous types. All of the micrococci were Gram-positive and catalase-positive and grew well in 6.5 per cent sodium chloride. They were non-pigmented except for group 6 and all of them were large cells

TABLE 2

Distribution of groups of micrococci and other bacteria isolated from raw milk cheese

Group no.	Total isolates	Cheeses in which group was found
	(%)	(%)
1	25	100
2	13	75
3	13	34
4	5	50
5	7	40
6	15	75
Coliforms and misc. types	22	100

occurring in tetrads or irregular masses. No growth occurred in broth containing sodium azide. The chief differences in these groups are recorded in table 1 and the distribution of these organisms in the raw milk cheeses is recorded in table 2. Several colonies were isolated from the plates made on the pasteurized milk cheeses. Most of these colonies were yellow pigmented micrococci similar to those in group 6.

Representative cultures from each group of micrococci were identified as closely as possible by the use of the differential characteristics suggested by

TABLE 3

Effect of Streptococcus lactis on the growth of micrococci in skim milk at 30° C.

Culture no.	Group no.	Micrococcus count when equal inocula of *S. lactis* and *Micrococcus* sp. were used	
		Initial	2 d.
		(All counts × 1000)	
273	1	13,900	170,000
325	1	8,000	140,000
361	1	1,500	35,000
556	1	2,400	30,000
396	2	700	2,400
552	2	1,300	< 100
572	2	750	14,000
651	2	1,300	200
476	3	3,100	250
729	3	215	1,300
557	4	90	2
688	5	1,000	820
298	6	6,000	< 100
627	6	400	400
722	6	7,000	< 100

Hucker (5) and Bergey's Manual (1). The members of groups 1, 2 and 4 were most closely related to *Micrococcus freudenreichii;* groups 3 and 5 were most closely related to *Micrococcus caseolyticus;* and group 6 was identified as *Micrococcus conglomeratus.*

The results of attempts to grow representative organisms from each group

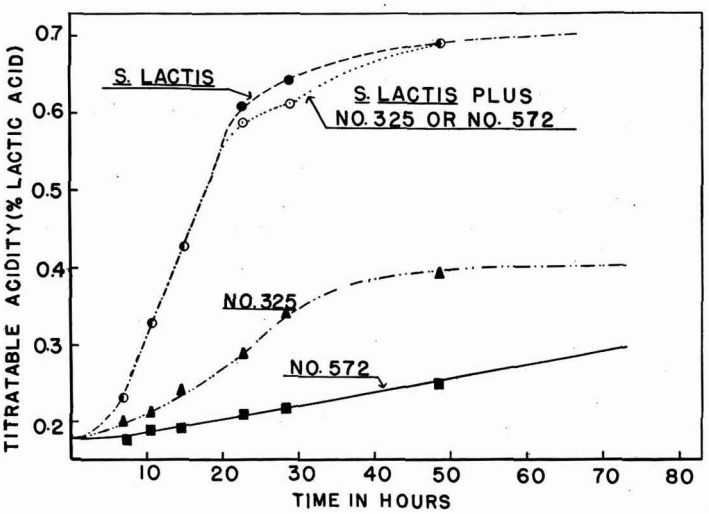

FIG. 3. Development of acidity in skim milk at 30° C. by pure and mixed cultures of micrococci and *Streptococcus lactis.*

with *Streptococcus lactis* are recorded in table 3. All of the cultures from group 1 and about half from group 2 showed a decided increase in count after 2 days of incubation with *S. lactis.* Only one culture in group 3 and none in the remainder of the groups showed an increased count after 2 days.

The effect of representative cultures on the production of acidity by *Streptococcus lactis* is given in figure 3. It is apparent from these data that the addition of micrococci would have little effect on the development of acidity during the manufacture of the cheese.

DISCUSSION

Comparison of the flora of raw milk cheese with that of pasteurized milk cheese indicates that the non-lactic bacteria are present in sufficient numbers in cheese made from raw milk to be of significance in its ripening. Yale and Marquardt (10) found that 10,000,000 coliforms per g. would cause sufficient development of gas to affect the quality of the cheese. If this number of coliform bacteria can bring about such a definite chemical change in the matter of a few hours, it is reasonable to assume that a smaller number of organisms could bring about the changes resulting in the development of flavor.

Although the micrococci isolated from cheese were different in many respects, they all were classified as *M. freudenreichii, M. caseolyticus,* or *M. conglomeratus.*

Some of the characteristics that were used to indicate the possible importance of the micrococci in cheese ripening were not necessary for the differentiation of species. This emphasizes the difficulty of classification of cultures for specific purposes or showing unusual characteristics on the basis of conventional differential tests. However, the present knowledge of bacterial taxonomy has not clearly indicated what constitutes a fundamental characteristic for differentiation of species and what should be considered as a characteristic of incidental value; therefore, any additional arbitrary designation of new species would only add to the present confusion.

The growth of micrococci of groups 1 and 2 at a pH less than 5.5 and the ability of these organisms to grow appreciably in the presence of *S. lactis*, as well as their lipolytic ability, indicates that they might be of value in increasing the rate of flavor development when added to pasteurized milk cheese. The results of investigations in which the micrococci were added to pasteurized milk for cheese making will be reported in a subsequent paper.

SUMMARY AND CONCLUSIONS

1. By the use of a tryptone agar medium that would not support good growth of the lactic acid bacteria, it was possible to show that cheese made from raw milk contained 500,000 to 50,000,000 non-lactic bacteria per g. by the time the cheese was 2 days old. The maximum counts obtained on cheese made from the same lot of milk that had been pasteurized were never more than 50,000 per g.

2. In raw milk cheese that developed a good flavor, micrococci were the predominant non-lactic organisms present in the early stages of ripening.

3. Seven groups of micrococci were isolated and separated on the basis of characteristics indicative of potential value in cheese ripening. These organisms were identified as *Micrococcus freudenreichii, Micrococcus caseolyticus,* and *Micrococcus conglomeratus.* Certain strains of *M. freudenreichii* grew in the presence of *Streptococcus lactis* and had other characteristics indicating that they might be involved in the ripening of cheese made from raw milk.

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EFFECT OF MICROCOCCI ON THE DEVELOPMENT OF FLAVOR WHEN ADDED TO CHEDDAR CHEESE MADE FROM PASTEURIZED MILK[1]

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There have been relatively few experiments in which selected strains of micrococci were added to cheese milk before it was set in an effort to increase the rate of ripening. Evans *et al.* (3) were able to show some improvement in flavor development in cheddar cheese when micrococci were added to the pasteurized milk in conjunction with streptococci and lactobacilli. Hansen (6) and Harris and Hammer (7) obtained an increased flavor production with selected strains of micrococci in cheddar cheese. Deane (2) isolated an acidoproteolytic micrococcus from a 4-yr. old cheddar cheese and added it, along with the regular lactic starter, to cheddar cheese made from raw milk; he found a markedly improved flavor development. Gorini (5) has emphasized the importance of acidoproteolytic cocci in cheese ripening. On the other hand, Hucker and Marquardt (8) obtained a bitter flavor when they added a proteolytic micrococcus to the cheese milk.

The results of the investigations on the growth and physiology of the different groups of micrococci isolated from raw milk cheese, reported in an earlier paper (1), indicated that two groups of cultures were of possible importance in cheese ripening. These two groups, which accounted for 38 per cent of the cultures isolated, were found in nearly all of the raw milk cheeses examined, and only occasionally were encountered in cheese made from pasteurized milk.

The present investigation was concerned with the effect of the addition of these selected micrococci on the development of flavor in cheese made from pasteurized milk.

EXPERIMENTAL PROCEDURE

The micrococci used in this investigation were representative organisms from the two groups of micrococci that had been isolated from raw milk cheese and shown to be of possible importance in affecting the flavor of cheddar cheese (1). Both of these groups of micrococci were identified as strains of *Micrococcus freudenreichii,* although cultures in group 2 would hydrolyze butterfat, whereas those in group 1 would not.

The cultures were grown in sterilized skim milk for 24 to 30 hr. at 30° C. and added to the cheese milk with the regular lactic starter. A 1 to 3 per cent inoculum was used, the acidity of which varied from 0.25 per cent to 0.55 per cent, de-

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pending upon the culture being studied. The cheese was manufactured in 50-lb. vats according to recommended procedures (10). It has been shown by Knight (9) that grinding of cheese 2 to 3 wk. after manufacture hastens the development of flavor. Since the present investigation was concerned primarily with the effect of non-lactic types of bacteria on the development of flavor rather than their effect on body and texture, grinding was used to speed up the ripening process. All cheeses were stored at 5 to 7° C. during ripening.

An additional method of determining the effect of micrococci on the development of flavor was carried out as follows: Large volumes of cells were grown in an aerated carrot-liver medium (4). These cells were collected by means of a Sharples centrifuge and added to freshly ground, 2- to 3-wk. old cheddar cheese that had been made from pasteurized milk. After thorough mixing of the cheese and cells, the cheese was reground, packed in aluminum foil and waxed.

RESULTS

The growth in cheddar cheese of representative cultures of micrococci from groups 1 and 2, both of which are strains of *M. freudenreichii,* is recorded in figure 1. Beginning with an inoculum of approximately 1,000,000 organisms per

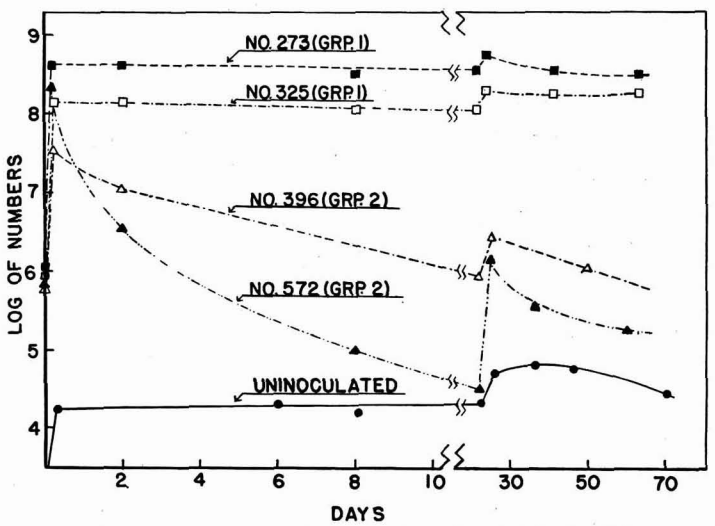

FIG. 1. Non-lactic count on pasteurized milk cheese inoculated with different strains of *M. freudenreichii.* Cheese ground at 26 d.

ml. of milk, no. 325 and 273 (group 1) increased to 200,000,000 per g. of cheese by the time the cheese was put to press. Similar increases in numbers during manufacture were shown by members of group 2 (no. 396 and 572). There was a small increase in count in the uninoculated control cheeses but it could be accounted for largely on the basis of concentration of cells in the curd.

The counts of micrococci in cheeses inoculated with members of group 1 de-

creased very slowly throughout the period of holding, although they did show a slight rise at the time the cheese was ground. When micrococci of group 2 were added to the cheese, they decreased rapidly during the first 10 days of ripening. By the time the cheese was ground there were few viable cells in the cheese. Grinding caused an increase in numbers but the micrococci again disappeared rapidly. Part of the increase at grinding may have resulted from breaking up of clumps and colonies and part probably was actual growth. It has been shown (1) that these organisms are capable of growth at the pH of cheese.

The effect of these organisms on the development of flavor in cheese is shown in figure 2. During the first few months, the development of flavor was more

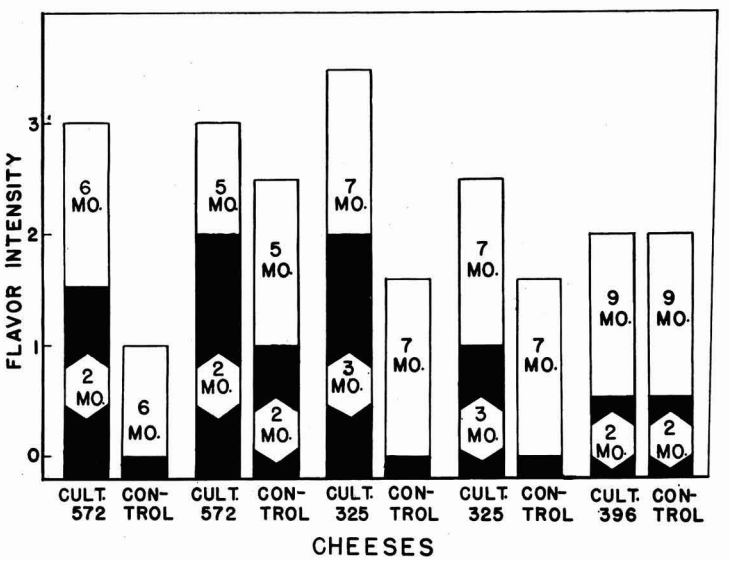

FIG. 2. Flavor development in pasteurized milk cheese inoculated at the time of manufacture with different strains of *M. freudenreichii*.

rapid in cheeses to which the micrococci were added than in the uninoculated controls. For example, in the first cheese to which culture 572 (group 2) was added, a flavor intensity of 1.5 was present in 2 mo., whereas none of the characteristic cheddar flavor was present in the control. Between 2 and 6 mo., however, both cheeses increased in flavor intensity by approximately the same amount. The other cheeses inoculated with cultures 572 (group 2) and 325 (group 1) also showed a more rapid flavor development during the early months than was found in the uninoculated control. All strains of micrococci were not effective, however, as is shown by no. 396, a member of group 2.

A few samples of the cheeses to which micrococci were added were not ground in order to check the effect of grinding on flavor development. Although the unground samples did not show as rapid or extensive development of flavor as

did the ground cheese, they did contain more flavor than similar samples of the uninoculated cheese.

It was necessary to carry the micrococcus to be used as a starter in a culture separate from the regular lactic starter. When the micrococcus was added to the regular lactic starter and transferred serially with it, the micrococcus disappeared from the mixture in four or five transfers.

The results of the addition of large masses of cells to ground cheese is shown in figure 3. The heavy inoculum of cells resulted in a rapid development of

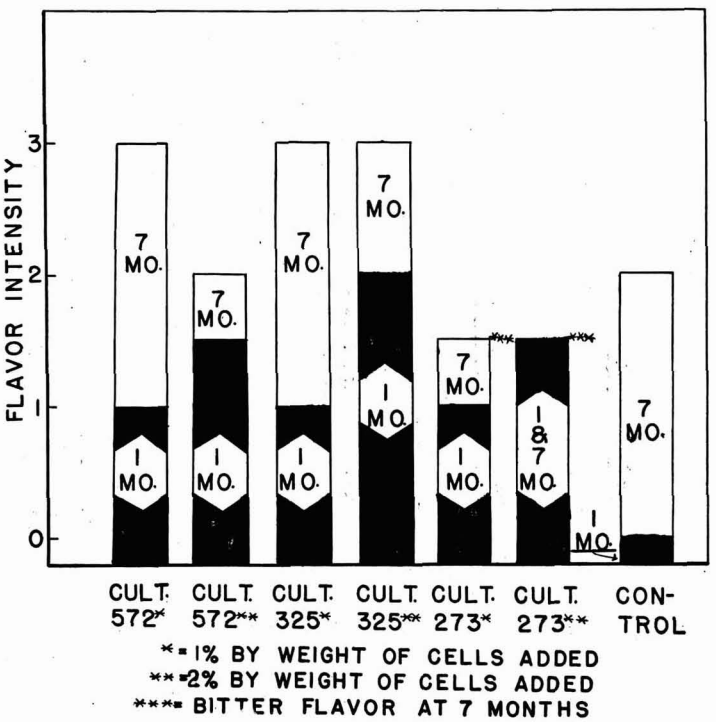

FIG. 3. Flavor development in pasteurized milk cheese ground and inoculated with strains of *M. freudenreichii* at the age of 2 wk.

flavor in all cheeses as compared to the control cheese. With culture no. 273, however, a bitter flavor developed on continued holding. This suggests that certain desirable micrococci must be added in smaller numbers than others to avoid the development of undesirable flavors. These data support those in figure 2 and indicate that the development of flavor in cheese containing certain strains of *M. freudenreichii* was faster than in cheeses to which only a lactic starter had been added and that this effect was most pronounced during the early months of ripening. The total plate count on tryptone agar in these cheeses amounted

to 1 to 5 billion cells per g. immediately after the addition of the inoculum. Culture no. 572 (group 2) disappeared rapidly as it had done when added to the cheese milk, whereas no. 325 and 273 (group 1) displayed the typical slow decline.

Total volatile acidity and water-soluble nitrogen in the cheese could not be correlated with the effect of the micrococci on flavor development.

DISCUSSION

The results of this investigation substantiate those of other workers by indicating that micrococci may improve the flavor of pasteurized milk cheese. Some strains of *M. freudenreichii* disappeared very rapidly from the cheese when added during manufacture yet caused an improvement in flavor. Other strains still were present in comparatively large numbers when the flavor had developed.

Some investigators, in studying the effect of microorganisms on cheese ripening, have attempted to separate the activity of bacteria from the activity of enzymes by establishing conditions that prevented bacterial growth. In view of present day knowledge of the activity of bacterial enzymes, it is unlikely that any such distinction can be made. Even though certain of the enzyme systems of the bacteria are blocked by the addition of chemicals and as a result the bacteria do not proliferate, it is known that the remaining enzymes will continue to act until exhausted or an equilibrium is reached. Apparently, therefore, bacteria of any group that occurs in sufficient numbers during manufacture and early ripening of cheese, may have a significant effect on the over-all ripening of cheese even though the viable count on these organisms decreases rapidly.

Certain strains of *M. freudenreichii* isolated from raw milk cheese are capable of hastening the development of flavor in pasteurized milk cheese. Undoubtedly, the micrococci are not the only bacteria involved in the development of flavor, but since they may be present in significant numbers in raw milk cheese, it is necessary to consider them as a factor in the development of the typical, but elusive, "cheddar flavor." The addition of selected strains of these organisms might be of value in improving the development of flavor in the commercial manufacture of cheddar cheese made from pasteurized milk.

SUMMARY AND CONCLUSIONS

1. Selected strains of *Micrococcus freudenreichii* were found to cause an increased rate of flavor development during the early months of ripening of cheddar cheese.

2. Some of the strains of *M. freudenreichii* that caused an accelerated rate of flavor development increased to their maximum numbers by the time the cheese was placed in the press, then decreased slowly over a period of several months. Other strains showed a similar increase during manufacture, then rapidly decreased in numbers. Both of these types of micrococci produced an increase in the rate of flavor development in cheese made from pasteurized milk.

3. The addition of large masses of micrococci to pasteurized milk cheese when it was ground at the age of 2 to 3 wk. resulted in a rapid development of flavor during curing at 5 to 7° C.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of W. V. Price in the manufacture, packaging, and determination of flavor in the cheeses, and the assistance of W. C. Winder and A. R. Swanson in judging the cheeses.

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INHERITANCE OF SUSCEPTIBILITY TO MASTITIS[1]

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Clinical reports and family histories which indicate some hereditary basis for susceptibility to mastitis are numerous. Most of these concern isolated cases which came to attention merely because they seemed so unusual. Murphy *et al.* (1) have reviewed this literature. Ward (2) has published preliminary results from nine herds surveyed systematically so as to gather all the information, whether conspicuous or not.

The present note is to call attention to some data which show that inheritance plays a part worth attention and to a method of measuring roughly how much the hereditary differences in susceptibility to mastitis have to do with determining whether or not an individual cow develops mastitis.

SOURCE OF DATA

The data were printed on page 60 of the 21st Annual Report of the New Zealand Dairy Board, which is for the year ending July 31, 1945 (3). The data came from 15 herds in the Canterbury District and 12 herds in the Manawatu District, chosen because they were conveniently located and the owners were especially interested in mastitis. Cooperating farmers were asked to keep full details of all clinical cases of mastitis occurring and to notify the Consulting Officer immediately. The working definition of clinical mastitis was: "All quarters which are abnormal or which are giving abnormal milk. This includes any quarters showing discoloured milk, clots, sediment, or watery milk; also any quarters showing hardness, pain, swelling, or other similar abnormal condition." The details concerning the leucocyte counts, fraction of cases in which streptococcus or staphylococcus organisms were found, apparent connection with seasonal or managemental conditions, etc., can be read in the report. On the basis of these tests each cow was classified as "susceptible" if she developed mastitis at any age or as "resistant" if she had not developed mastitis and had reached at least 8 yr. of age. Since mastitis manifests itself in many degrees of severity, this grouping into only two classes is a bit arbitrary and doubtless loses some of the information really in the data. In this respect, however, it seems no more and no less valid than any other grouping of a continuously distributed variable into only two classes, such as high and low producers, or kept and culled.

The tables include all dams who reached at least 8 yr. and were classified as susceptible or resistant themselves and who had any daughters grow up to be classified as susceptible or resistant. The susceptible dams are listed in one column and the resistant dams in another. Opposite each group is shown the percentage of susceptibles among their daughters. This was done separately for each herd.

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[1] Journal Paper no. J-1718 of the Iowa Agricultural Experiment Station, Ames, Project no. 1053.

Table 1 shows, as an example, how this was done for the first six herds in the Manawatu district. Two columns are added to show how the data from all herds were combined to yield the totals at the bottom of the table.

TABLE 1

Sample data showing how the evidence was combined

Herd No.	Susceptible dams		Resistant dams			
	No. (n)	% daughters susceptible (x)	No. (k)	% daughters susceptible (y)	x-y	$\frac{nk}{n+k}$
1	23	87.0	18	66.7	20.3	10.10
2	5	80.0	6	33.3	46.7	2.73
3	17	94.2	15	66.7	27.5	7.97
4	1	100.0	2	100.0	0.0	.67
5	15	80.0	21	61.9	18.1	8.75
6	7	71.5	8	50.0	21.5	3.73
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
Totals:[a]						
Manawatu	128		171		1034.48	64.06
Canterbury	86		109		919.72	35.57
Averages (weighted):						
Manawatu	.....	81.3	.....	54.4	16.1	
Canterbury	.....	89.5	.....	56.0	25.9	
Pooled					19.6	

[a] The totals in the *x-y* column are of the *x-y* for each herd times its $\frac{nk}{n+k}$, as the best measure of the amount of information that herd contributes.

The evidence on heritability consists simply in whether susceptible dams have a higher percentage of susceptible daughters than the resistant dams in the same herd. This amounts to an intra-herd regression of daughters on dams. That is, the two groups of dams are 100 per cent apart in their phenotypic susceptibility when classified in this way. If 80 per cent of the daughters of the susceptible dams were susceptible while only 60 per cent of the daughters of the resistant dams were susceptible, the average susceptibility of the two groups of daughters would differ by 20 per cent, whereas their dams differed by 100 per cent. Such an outcome—unselected daughters differing only one-fifth as much as their individually selected dams—would indicate that the heritability of this phenotypic difference between individual dams was two-fifths, since it is assumed that the sires of the two groups of daughters would be about equal to each other in anything they would transmit in regard to susceptibility to mastitis and, therefore, that the phenotypic averages of the unselected daughters would differ by only half as much as the genic averages of their dams. Indeed putting the analysis on an intra-herd basis means that in many cases the very same individual bulls were sires of daughters from the resistant and also from the susceptible dams.

The mean incidence of mastitis appears to vary widely from herd to herd but those differences do not affect the interpretation here[2] since the x-y column con-

[2] Except in choosing a suitable weighting scale for combining the evidence from the different herds.

cerns only intra-herd differences. If the intra-herd environmental differences which influence whether a cow comes down with mastitis were randomized as between daughter and dam, the regression of daughter on dam should show only a genetic relationship plus some sampling variations from Mendelian segregation and from the impact of those intra-herd environmental differences not being wholly equalized in numbers of cows as few as these. Doubling x-y yields an estimate of how much of the phenotypic difference between the dams being "susceptible" and "resistant" was due to genic (= additively genetic) differences between them, plus possibly a bit of the epistatic effect if any. This estimate is subject to considerable sampling error because the data were moderately few.

Some method of weighting is necessary for combining the evidence from the various herds, since the herds varied widely in the total number of dams which were classified and also in the proportion of dams in the two groups. The weight $\frac{nk}{n+k}$ was chosen as proportional to the amount of information from each herd, since it is proportional to the inverse of the variance if the true proportions of susceptibles among the daughters really were the same in all the herds. Weighting in proportion to $\frac{nk}{ny(100-y)+kx(100-x)}$ would have seemed more appropriate if one could have assumed that the observed x and the observed y were really typical for each of the herds involved, but that method was rejected as unsuitable because of the small numbers and especially in view of the difficulties which arise with it when either x or y is 100 or zero. An angular transformation seemed unproductive for percentages with such small denominators as these. The method used may have underemphasized a bit the evidence from herds in which either x or y was zero or 100 per cent but it is not believed that the bias is serious, especially when compared with the sampling errors.

The average intra-herd regression of daughter on dam, using this method, was 0.161 for the 12 Manawatu herds and 0.259 for the 15 Canterbury herds. The average for all 27 herds was 0.191. The standard deviation of this estimate would be not far from 0.08, since the sum of the weights is equivalent to about 100 susceptible dams and 100 resistant dams, if n and k were alike in the same herd although variable from one to another of the 27 herds. Therefore the P = 0.05 fiducial limits for the regression of daughter on dam would be about 0.16 above or below the observed 0.19. This yields an estimate that heritability of individual differences in susceptibility to mastitis is about 0.38 but that the 95 per cent confidence interval for this would range from in the neighborhood of 0.06 up toward 0.70. In short, the evidence is good that heredity plays some part and the unbiased indication is that it is a moderately large part in whether a cow develops mastitis, but the data are too few to locate that within narrow limits.

DISCUSSION AND QUALIFICATIONS

The all-or-none nature of the classification tends to make the regression less than would be found if susceptibility to mastitis could be measured in many dif-

ferent grades. This effect is small where the two groups of dams are as nearly equal in numbers as they were here.

That the standards for classifying the animals into susceptible and resistant groups were rather severe is indicated by the fact that 42 per cent of the dams and about 70 per cent of the daughters were classified as susceptible. Since the dams were all at least eight years old, prior culling of some cows on mastitis explains partially the lower figure for the dams. The rest of the explanation is that daughters which were under 8 yr. of age and had not developed mastitis were merely omitted from the data on the grounds that they might yet develop it before reaching eight. Had these daughters been included as resistant (personal communication from Ward and Castle in 1949) the percentages of susceptible daughters would have been 66 and 44 instead of 81 and 54 in Manawatu and would have been 67 and 43 instead of 89 and 56 in Canterbury. This would not have changed the general conclusion.

How far one can generalize from these data is uncertain, especially in view of the wide fiducial limits. They do agree well with the reports reviewed by Murphy *et al.* (1). The herds in this New Zealand study included some with high and some with low incidence of mastitis but presumably their average incidence was a bit higher than in the general population in New Zealand, as the owners were interested in the problem enough to cooperate thoroughly with the Consulting Officers. The difference between the Canterbury average and the Manawatu average is only about the size of its standard error, so there is little indication here that the two sets of herds really differed. Some causes of mastitis which might be important in other countries are presumably absent from or negligible in New Zealand dairying where the herds are on pasture all the time and there is little or no opportunity for injury in barns or for damage from lying on cold floors.

This method of investigation appears worth extending to a much larger body of data. The wide fiducial limits found for the heritability value indicate how many herds need to be included for those limits to be narrowed as much as it is desirable that they should be. To get the standard error of the regression as low as 0.04 would require about 400 susceptible and 400 resistant dams.

Whether a heritability value of about 0.4 appears unreasonably high depends obviously, on one's prior opinions. Insofar as ability of the cow to combat and overcome the disease depends on the anatomical structure of the mammary gland, a value this large appears reasonable, since many details of anatomical structure are highly hereditary. So far as the cow's overcoming the disease depends on her general state of health, a value of 0.4 appears surprisingly high, since general health is affected by so many external circumstances.

If heritability really is this high, culling of the affected individual cows and paying a moderate amount of attention to not using bulls whose sisters or dams were susceptible should reduce the incidence of mastitis in dairy herds rather rapidly per cow generation. Since the parents average about five years old when the dairy calf is born, even a rather rapid amount of such genetic improvement per generation might appear disappointingly slow to one who has mastitis widely

prevalent in his herd at a given time. The fact that mastitis is still so prevalent and that mass selection should be reasonably effective if heritability is this high and that selection against low production must automatically involve considerable selection against mastitis, makes it seem doubtful that heritability is in fact as high as .4. Or perhaps the same genes or anatomical structures which predispose to susceptibility to mastitis may also predispose to high production or to some other characteristic for which selection is positive. This question of intercorrelations (either genetic or environmental or both) between characteristics is so speculative at the moment that further discussion of it here seems fruitless. Yet it remains clear that daughter and dam do resemble each other in susceptibility to mastitis closely enough that culling those most affected should lessen the incidence and severity of mastitis.

Ward and Castle have used the present method in a preliminary study of fertility in 12 herds (personal communication in 1949) and have found intra-herd daughter-dam regressions of 0.08, 0.08, and 0.15 according to whether the daughters were classified as infertile when they were (a) empty their first year, or (b) empty either of their first two years, or (c) empty either of their first three years. The dams were classified according to their performance in a five-year period before they were nine years old. If the dams calved in all five years or if their fertility index was less than two services per conception they were classified as highly fertile, while if they were empty one or more of the years or if their fertility index was higher than two services per conception they were classed as of low fertility. Since the numerator and the denominator of the regression coefficient in this case are not in exactly the same units, some adjustment for the variation not being alike in the two kinds of units might need to be made if these regressions are to be converted into estimates of heritability. Such adjustment would be small since both units are percentages in a two-way classification.

SUMMARY

The average intra-herd regression of daughter on dam within 27 herds in New Zealand was 0.19 for whether they came down with mastitis. Since the 95 per cent confidence interval for this is of the order of 0.03 to 0.35 its true magnitude in the population from which these data are a sample is not known closely; yet it appears that differences in susceptibility to mastitis have a strong genetic background. Selection against cows which are severely affected or have severely affected sisters or daughters should lower the incidence of mastitis. The method of investigation appears worth extending to more data.

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THYROPROTEIN IN THE RATION OF DAIRY CATTLE. I. ITS INFLUENCE ON MILK PRODUCTION, FAT TEST, HEART RATE AND BODY WEIGHT[1]

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INTRODUCTION

In considering the possibilities of feeding thyroprotein on a commercial basis, it is important to know whether sufficient thyroxine is secreted in the milk to affect the consumer. In producing milks for such a study, certain observations were made on cows fed thyroprotein and others not receiving thyroprotein. These observations, along with results on additional animals, are presented in this paper. The results on the milk study have been reported elsewhere by Bruger *et al.* (1).

EXPERIMENTAL PROCEDURE

Four dairy cows past their lactational peaks each received 15 g. of thyroprotein (Protamone[2]) daily for 16 wk. No attempt was made to select cows that might respond well to thyroprotein feeding. The thyroprotein was incorporated in the morning grain ration. During the entire feeding period, daily milk weights (twice-daily milkings) were recorded and milk samples were taken on 2 consecutive days every other week. Individual milk samples were tested for their butterfat content (Gerber method) and solids-not-fat content (by means of a lactometer). In an attempt to determine the influence of thyroprotein feeding on milk production in each cow, the rate of decline prior to thyroprotein feeding was determined and the lactation curve projected on this basis. Body weights and heart rates (measured with a stethoscope) were determined on 2 consecutive days every other week. Similar observations were made on four additional cows that did not receive thyroprotein. This group of cows cannot be considered strictly as a control group because the groups were not well balanced. The observations are presented, however, for comparison. These observations all were made during the barn-feeding period. Fifteen g. of thyroprotein were fed daily for various periods, to an additional four cows on which observations were made only on milk production. The cows were maintained under average farm conditions, grain being fed according to milk production. A description of the cows on which observations were made is given in table 1.

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[2] The Protamone was generously supplied by the Cerophyl Laboratories, Kansas City, Missouri, through the courtesy of W. R. Graham, Jr.

TABLE 1

Description of cows on which observations were made

Cow no.	Breed	Age	Received thyro-protein	Mo. of lactation	Mo. of gestation
		Yr. Mo.			
150X	Holstein-Fr.	12–2	Yes	5th	0
462	Ayrshire	9–9	"	4th	0
491	Ayrshire	5–9	"	6th	4th
637	Brown Swiss	2–10	"	5th	3rd
H-60	Holstein-Fr.	7–10	No	7th	2nd
626	Brown Swiss	5–5	"	8th	5th
628	Brown Swiss	5–1	"	2nd	0
467	Ayrshire	8–10	"	2nd	0
H-56	Holstein-Fr.	4–1	Yes	8th	5th
647	Brown Swiss	9–5	"	13th	0
648	Brown Swiss	5–7	"	6th	1
650	Brown Swiss	7–4	"	5th	0

EXPERIMENTAL RESULTS

Milk Production. In thyroprotein studies the initial response is of considerable interest. In the eight cows that received 15 g. of thyroprotein for various periods, the average increase in milk production from the week prior to thyroprotein feeding to the highest subsequent weekly production was 24.8 per cent (range 7.9 to 36.2). On the average, the cows attained their highest weekly average production during the second week of thyroprotein feeding. In the tenth week daily milk production was nearly identical to that of the week prior to thyroprotein feeding (31.6 lb. and 31.7 lb.). Of the eight cows, two attained the highest production in the second week of thyroprotein feeding, two in the third week, three in the sixth week, and one in the seventh week.

Four cows were fed 15 g. of thyroprotein daily for 16 or more wk., and during the same period observations were made on four additional cows that did not receive thyroprotein. The lactation curve for the cows not fed thyroprotein indicated no unusual herd conditions. Of the four cows fed thyroprotein, three had lactation curves that eventually dropped below their estimated curves. The fourth cow (637) gave an excellent initial response and her lactation curve remained above the estimated lactation during the entire feeding period. The feeding of thyroprotein may have increased her persistency. Prior to thyroprotein feeding her average rate of decline was 7.4 per cent, whereas during the feeding it was 4.1 per cent (fig. 1-A, B, C, D & E). The thyroprotein-fed cows decreased 32 per cent in milk production from the last 2-wk. period of feeding to the first 2-wk. period after thyroprotein withdrawal. During the same period, the cows not fed thyroprotein showed a 14 per cent decrease in milk production.

The influence of feeding 15 g. of thyroprotein daily on milk production was noted in four additional cows. One of these cows was a 4-yr. old Holstein-Friesian in her eighth month of lactation. Thyroprotein was fed for a 12-wk. period and in the last 2-wk. period her average daily milk production was 2.8 lb. above her estimated production (fig. 2). The three remaining cows were Brown Swiss, of which two were not pregnant and the third was in the first month of gestation. One cow (647), showed a maximum increase in daily milk produc-

tion of 3.5 lb., based on monthly averages. Five months after the incorporation of thyroprotein in the ration the level of milk production decreased to that of

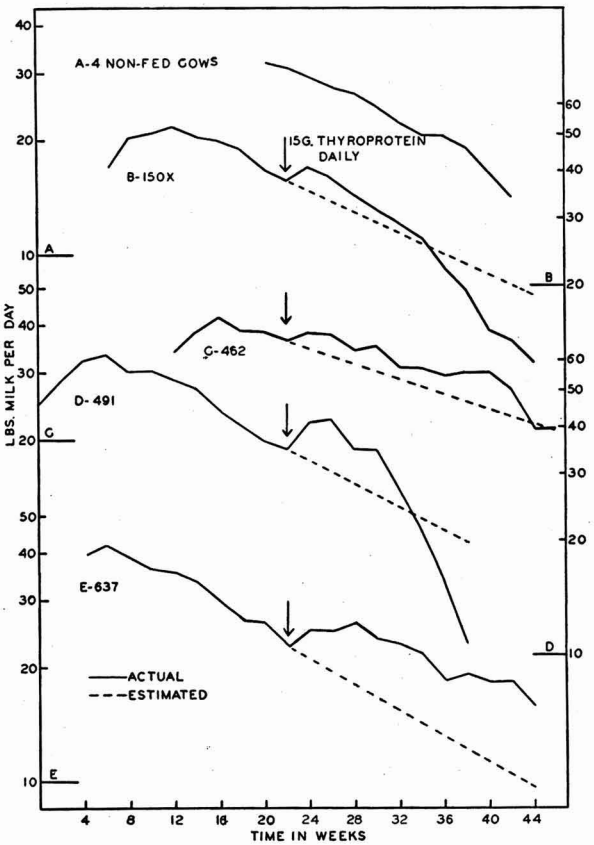

FIG. 1. The effect of feeding 15 g. of thyroprotein daily on milk production.

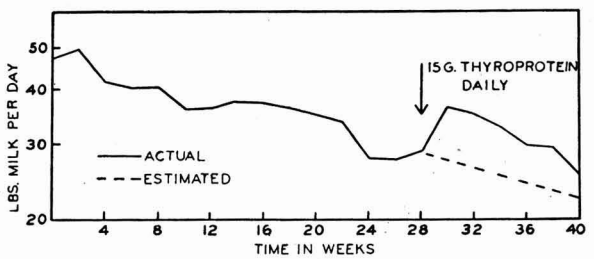

FIG. 2. The effect of feeding 15 g. of thyroprotein daily on milk production in a 4-yr.-old Holstein-Friesian cow (H-56).

her estimated production. In the seventh month of thyroprotein feeding the average daily milk production was 3 lb. higher than in the previous month. This increase in milk production may have been the result of an improvement in the nutritional condition of the animal, since the seventh month of thyroprotein feeding was her first full month on pasture following the incorporation of thyroprotein in the ration. In the ninth month of thyroprotein feeding, the 21st full month of lactation, the average daily milk production was 2.3 lb. above the estimated production (fig. 3). It was not possible to project the lactation curve of the second Brown Swiss cow (648) since there had been no decline in lacta-

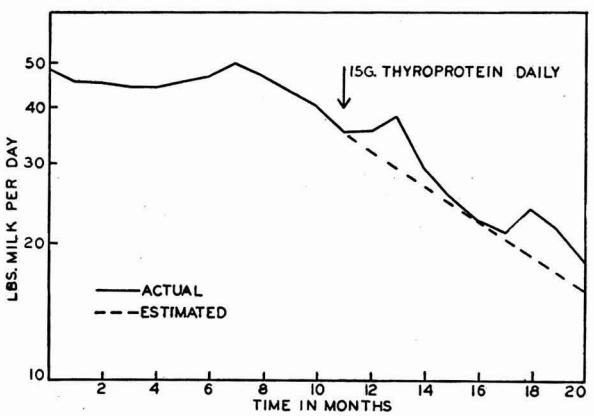

FIG. 3. The effect of feeding 15 g. of thyroprotein daily on milk production in a 9-yr.-old Brown Swiss cow (647).

tion prior to feeding thyroprotein. Based on monthly averages, daily milk production increased from 33.3 lb. to 40.8 lb. in the third month of thyroprotein feeding. The third month of thyroprotein feeding was the first full month that 648 was on pasture following the addition of thyroprotein to the ration. In the seventh month of thyroprotein feeding, and the 13th month of lactation, 648 averaged 22.1 lb. of milk daily (fig. 4). Thyroprotein was incorporated in the

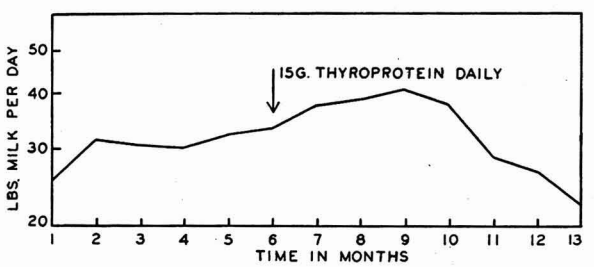

FIG. 4. The effect of feeding 15 g. of thyroprotein daily on milk production in a 5-yr.-old Brown Swiss cow (648).

ration of a third Brown Swiss cow (650) in the sixth month of lactation. Average daily milk production increased from 34.4 lb. to a maximum of 43.5 lb. in the second month of thyroprotein feeding. During the subsequent 6 mo. there was a decline in milk production, the decline being similar to that of the estimated lactation. In the eighth month of thyroprotein feeding, and the thirteenth month of lactation, the average daily milk production was 25.2 lb., or 8.9 lb. above the estimated production (fig. 5).

Fat test. The butterfat test of the thyroprotein-fed cows increased from 3.69 to 4.37 per cent and then decreased to 4.09 per cent, at which level it was

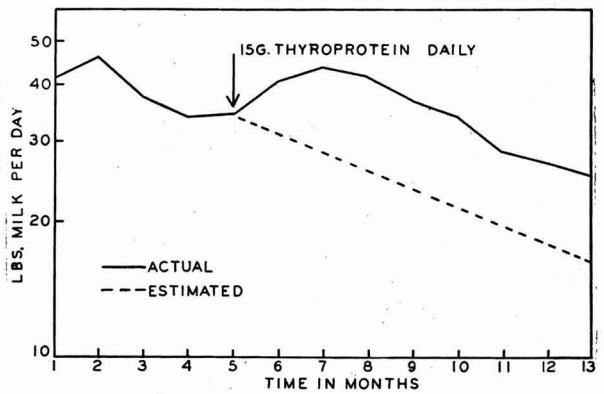

FIG. 5. The effect of feeding 15 g. of thyroprotein daily on milk production in a 7-yr.-old Brown Swiss cow (650).

maintained for the remainder of the feeding period. The butterfat test of the cows not fed thyroprotein remained fairly constant for 8 wk., after which it increased (fig. 6-A).

Solids-not-fat. The solids-not-fat content of the milk of thyroprotein-fed cows increased and then decreased slightly. At the end of the 16-wk. feeding period the solids-not-fat content was similar to that at the beginning of the trial. In the cows not fed thyroprotein the solids-not-fat content fluctuated somewhat; however, there was a slight increase (fig. 6-B).

Heart rate. In the cows fed thyroprotein the heart rate increased from 62 to 86 beats per min. and remained fairly constant for 12 wk. Heart rate then decreased to 78 beats per min. and in the final 2-wk. period the average heart rate was 82. In the cows not receiving thyroprotein, heart rate decreased slightly and then increased to within three beats per min. of the initial level (fig. 6-C). In the 2-wk. period following the withdrawal of thyroprotein from the ration the cows showed a decrease in heart rate of 17 beats per min. The cows that had not been fed thyroprotein showed an increase of 3 beats per min.

Body weight. In the cows receiving thyroprotein the average body weight decreased from 1,198 lb. to 1,126 lb. and then steadily increased to 1,175 lb.

During the same period, the body weight of the cows not receiving thyroprotein increased from 1,173 lb. to 1,243 lb. In the last half of the feeding trial the weight increases in the two groups paralleled each other (fig. 6-D). In the 2-wk. period following the withdrawal of thyroprotein from the ration, the cows gained, on the average, 53 lb., whereas the cows that had not received thyroprotein showed no increase in weight.

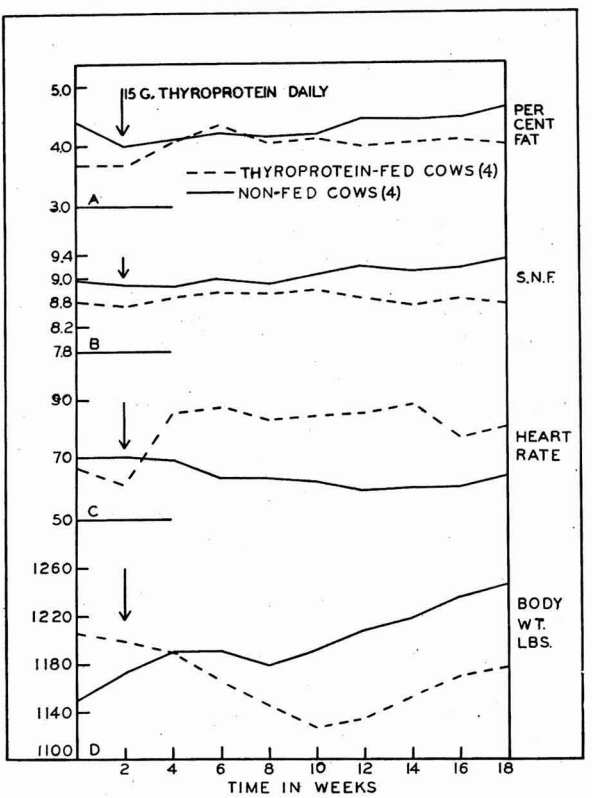

FIG. 6. The effect of feeding 15 g. of thyroprotein daily for 16 wk. on fat test, solids-not-fat, heart rate and body weight.

Reproduction. Of the eight cows that were fed thyroprotein four were pregnant at the beginning of the feeding period. These four cows had gestations, parturitions and calves that were normal. One cow (650) had been bred three times prior to thyroprotein feeding and had not conceived. She conceived on the fifth service during thyroprotein feeding and gave birth to a normal calf at the end of a normal gestation period. Another cow (647) had failed to conceive following ten services before being fed thyroprotein. She conceived on the third service after the incorporation of thyroprotein in the grain ration. Her

gestation, parturition and calf were normal. Two cows were open during the entire thyroprotein feeding period. One of these cows (462) was bred twice during the feeding period, but she did not conceive. She conceived on the first service after thyroprotein withdrawal. At the end of a 265-day gestation period no. 462 gave birth to a calf that appeared normal except for size (birth weight 20 lb.). The cow was negative to the blood test for Bang's disease.

DISCUSSION

Of the eight dairy cows fed 15 g. of thyroprotein, all showed an initial response to thyroprotein feeding. The response, however, was variable. This is in agreement with other investigations. Not all of the cows continued to produce above their estimated production. Lactation curves were projected for seven cows. Four of the curves remained above and three dropped below the estimated production. Of the four cows that maintained lactation curves above the estimated curves, three were Brown Swiss and the fourth was a Holstein-Friesian that received thyroprotein for a 12-wk. period. Of the three cows whose lactation curves dropped below the estimated curves, one was a Holstein-Friesian (150X) in rather poor physical condition at the start of the feeding trial, and two were Ayrshires. If actual and estimated lactation curves are plotted on semi-log paper, it is believed that one can determine fairly well when it is advantageous to continue the feeding of thyroprotein and when it is advantageous to withdraw it from the ration.

The fat content of the milk of the thyroprotein-fed cows increased from 3.69 per cent to 4.37 per cent. This increase in the fat content of the milk accompanied a decrease in body weight. Although body weight continued to decrease, the fat content of the milk was not maintained at the 4.37 per cent level. During the last 8 wk. of the feeding period there was an increase in body weight; however, the fat content of the milk remained fairly constant. The difference in the fat content of the milk, prior to, and at the end of the thyroprotein feeding period was about the same in the thyroprotein-fed cows and in the cows not receiving thyroprotein.

There was some indication that the solids-not-fat content of the milk may have been increased initially by thyroprotein feeding. After 8 wk. of thyroprotein feeding the solids-not-fat content of the milk returned to the pre-feeding level. On the other hand, the solids-not-fat content of the milk of cows not receiving thyroprotein was greater at the end of the feeding period than at the beginning. In one instance (150X) the solids-not-fat content increased from 7.84 per cent to 8.12 and then decreased to 6.87 per cent, from which figure it increased to 7.37 per cent.

SUMMARY

The daily feeding of 15 g. of thyroprotein to eight cows resulted in an initial increase in milk production of 24.8 per cent (7.9 to 36.2). Of seven cows in which lactation curves were projected, four remained above and three dropped below their estimated production.

Thyroprotein feeding increased the fat content of the milk from 3.69 to 4.37

per cent. The fat test then decreased to 4.09 per cent at which level it was maintained until the end of the feeding period.

The solids-not-fat content of the milk increased and then decreased slightly during a 16-wk. feeding period.

The average body weight of four cows decreased from 1,198 lb. to 1,126 lb. and then steadily increased to 1,175 lb.

Heart rate increased from 62 to 86 beats per min. and remained fairly constant for 12 wk.

REFERENCES

(1) BRUGER, M., AND SILBERBUSH, F. F. Metabolic Studies in Children Fed Milk from Cows Receiving Synthetic Thyroprotein. J. Clin. Endocrinology, **6**: 565–569. 1946.

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ABSTRACTS OF LITERATURE

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ANIMAL DISEASES

W. D. POUNDEN, SECTION EDITOR

52. The control of Streptococcus agalactiae infection in herds by means of therapeutic treatment. S. J. EDWARDS and J. I. TAYLOR. Vet. Record, **61,** 47: 780–783. 1949.

One herd of 70 Ayrshire cows that had been tested regularly for *Str. agalactiae* infection for several years and was machine milked and stripped, with precautions taken to prevent the spread of mastitis, was studied first. Just prior to treatment, 54 cows were shown to be infected 22 showing clinical signs of mastitis. Infected cows were treated for 4 d. with 50 ml. of a 30% sulphanilamide emulsion in an oil-water base per quarter, and 61% of the infected cows responded to this treatment. Another treatment was given 2 wk. later using up to 8 daily injections if daily samples indicated infection was still present. Sulphanilamide finally was effective in 85% of infected cows treated. Remaining infected cows plus newly infected cows were treated with penicillin in water, using 4 daily injections of 100,000 units each per quarter. This treatment was successful and, with the exception of 3 new cases, the herd remained free of *Str. agalactiae* infection for over 2 yr.

Five more herds infected with *Str. agalactiae* were included, in which the incidence of infection was 21%. Treatment consisted of 4 daily injections of 40,000 units of penicillin in a 4.5% beeswax-oil base. In the first course of treatment, 31 of the 55 infected cows were treated and 24 served as controls. All but 2 of the treated cows responded, and in subsequent treatment of the 24 controls in which infection remained, all but one responded. Herds remained in the experiment for 20 mo., and in 2 herds the infection was eradicated, while in a 3rd herd it was reduced to a single cow that did not respond to successive treatments. In the 2 remaining herds the incidence was lowered for a short period, but rose repeatedly. Teat lesions and no precautions to prevent the spread of infection were believed to account for this.

The authors concluded that some cows infected with *Str. agalactiae* resist treatment from both sulphanilamide and penicillin, with penicillin being most effective. R. P. Niedermeier

53. A comparison of ante-mortem and post-mortem findings in bovine mastitis. D. MCFARLANE and P. S. BLACKBURN. Vet. Record, **61,** 49: 807–810. 1949.

This experiment was designed to obtain a comparison between the diagnostic value of cell count and culture tests and to determine whether typical mastitis pathogens are present in quarters producing milk of high cell content but free of pathogens. Fifty-four quarters with a record of high cell counts were examined and ante- and post-mortem data are presented. Cell counts of an animal were considered positive if the average count of the mid-lactation samples was over 100,000/ml. Post-mortem histological results were considered positive if there was evidence of what the authors term progressive or dormant mastitis. Pathological findings were present in 92% of the quarters with high cell counts, indicating that cell counts are a reliable method of diagnosis for mastitis.

In 39 quarters, a comparison was made between ante-mortem milk cultures and post-mortem udder tissue cultures, and 80% agreement was obtained. Further comparisons resulted in 56% agreement between ante-mortem culture tests and post-mortem tissue culture tests and histological examination. In 39% of the histologically positive quarters no typical mastitis organisms were found in the milk ante-mortem or in the tissues post-mortem, indicating a mastitic condition can exist even when culture tests are negative.

The authors conclude that culture tests of the milk are not as reliable for diagnostic work as cell count tests, and a non-specific form of bovine mastitis often may be present, although mastitis organisms or other pathogens are not present in the milk or udder tissues. R. P. Niedermeier

54. The agglutination reaction of bovine serum in the diagnosis of trichomoniasis. A. E. PIERCE, Ministry of Agriculture, Veterinary Labs., Weybridge, England. British Vet. J. **105,** 8: 286–294. Aug., 1949.

A large series of sera from normal and trichomonad infected cattle was checked with the agglutination test for aid in the diagnosis of bovine trichomoniasis (early abortion). Specific agglutinins to *Trichomonas foetus* were detected in the sera from known trichomonad infected herds. The test is regarded as a herd test. All tests must be carried out using 2 different strains of trichomonads. Of 179 samples, checked in duplicate, from infected herds 15 showed positive, 8 above normal, 17 slightly above negative and 139 negative. Animals showing a titer for *Brucella abortus* did not react to the trichomonas agglutination test. B. B. Morgan

55. Sulfamerazine and sodium sulfamerazine as therapeutic agents in cattle. R. H. WALKER, Pleasanton, Cal. and E. V. EDMONDS, Oakland, Cal. Vet. Med., **44,** 10: 415–417. Oct., 1949.

Fourteen of 16 adult cattle infected with foot rot responded satisfactorily to a single dose of 20–48 g. of sodium sulfamerazine given intravenously (12 animals) or intraperitoneally (2 animals). Twenty-three of 30 cases of several other infections also responded satisfactorily to 1 intravenous injection of an aqueous solution of sodium sulfamerazine at a dosage of 3–4 g./100 lb. body weight. The diseases included 7 cases of diphtheria, 7 cases of pneumonia, 4 cases of shipping fever, 4 cases actinobacillosis and 1 case each of tendonitis, infection of mandible, streptococcic infection of the jaw, sinusitis, septicemia (mastitis), necrotic vaginitis, infected wound and necrophorus skin infection. No toxic reactions were observed after infections of the drug in cattle.
B. B. Morgan

56. Quinoline diphosphate in experimental anaplasmosis. E. J. SPLITTER, Kansas State College, Manhattan. Vet. Med., **44,** 10: 418–419. Oct., 1949.

In a very limited experiment 2 splenectomized calves experimentally infected with *Anaplasma marginale* were treated either with quinoline diphosphate or quinoline phosphate. Neither drug showed any specific action against anaplasmosis.
B. B. Morgan

57. Cattle grub distribution in California. D. P. FURMAN, J. R. DOUGLAS and K. G. MCKAY, Univ. of Cal., Berkeley and Davis. J. Econ. Entomol., **42,** 5: 842–843. Oct., 1949.

Cattle grub collections from native cattle were made in 44 Cal. counties over a 2-yr. period. Both *Hypoderma bovis* (northern cattle grub) and *H. lineatum* (common cattle grub) were found in 34 counties. Each of the 2 species was found alone in 5 counties. *H. bovis* was distributed from northernmost to southernmost Cal. Presence of *H. bovis* in Imperial County, which borders Mexico, is thought to be its southernmost incidence in the U. S.

H. lineatum appears in cattle backs earlier than *H. bovis,* and is replaced by the latter species late in the season. Relative abundance of both species is not constant in all areas of the state. Where both are numerous, grubs emerge from cattle backs during a period of over 6 mo. In such cases 3 grub treatments at 30-d. intervals will not give adequate control. E. H. Fisher

58. An attempt to protect cattle from grub infestation by use of insecticides. O. H. GRAHAM, U.S.D.A., Bureau of Entomology and Plant Quarantine. J. Econ. Entomol, **42,** 5: 837. Oct., 1949.

Near Kerrville, Texas, cattle were sprayed each 2 wk., from Jan. 1 to Apr. 28, for common cattle grub control. The grub flies were active during this period. Wettable powders of DDT, DDD (TDE), methoxychlor, chlordan and toxaphene were used at 2% concentration. BHC at 0.24% gamma isomer plus 1.76% other isomers and a combination of 0.75% DDT and 0.03% gamma BHC plus 0.22% other isomers were included. Each cow's entire body was wet to the skin with 5 gal. of spray/animal, applied at 300 lb. pressure. All materials were applied 9 times, except chlordan; 3 of 10 cows sprayed with chlordan died after the 4th application.

Results were obtained by determining the numbers of grubs in the gullets and backs of cattle at various periods. No treatment completely protected cattle from infestation. The 0.24% gamma BHC treatment gave best control; however, this was a high concentration of the insecticide, and this material is not considered of great practical value for grub control if applied at safe concentrations only 2 or 3 times during the season of adult (fly) activity. E. H. Fisher

59. County-wide control of the horn fly with DDT. C. L. SMITH and D. E. GATES, U.S.D.A., Bureau of Entomology and Plant Quarantine. J. Econ. Entomol., **42,** 5: 847–848. Oct., 1949.

During the 1948 horn fly season, a county-wide horn fly control program was carried out in Kiowa County, Kan. The test plot covered 720 sq. mi. on which were about 25,000 head of cattle, including both beef and dairy breeds, and many farm buildings which needed treatment. Less than 1% of about 650 farm owners failed to cooperate in the cattle spraying. About 80–85% of the buildings were treated. Initial cattle sprays were applied between Apr. 26 and May 25. Retreatment was made when the flies averaged 25/animal.

Cattle spray was 0.5% DDT, made from a 50% DDT wettable powder. This was applied at 450–500 lb. pressure, using about 1 gal./animal. Building spray was 5% DDT, made from 25% DDT emulsifiable solution, applied at 75–100 lb. pressure.

Eradication of the horn fly from a large area was shown to be difficult, and 100% community effort is necessary for a successful program of this type. Data are presented. E. H. Fisher

60. Suspected buttercup poisoning in a Jersey cow. O. V. GUNNING, Acle, Nr., Norwich. British Vet. J., **105,** 10: 393. Oct., 1949.

A case history on a suspected buttercup poisoning in a Jersey cow is given. All of the symptoms pointed to poisoning, as the pasture was full of buttercups in the flowering stage. B. B. Morgan

BUTTER

O. F. HUNZIKER, SECTION EDITOR

61. Treating butterfat. C. E. NORTH. U. S. Patent 2,485,308. 6 claims. Oct. 18, 1949. Official Gaz. U. S. Pat. Office, **627,** 3: 811. 1949.

The flavor of rancid butterfat may be improved by emulsifying the objectionable fat with skim milk powder and water at a temperature about that at which the fat melts, to form a cream of about 35–40% fat. After cooling the remade cream is churned and the fat recovered.

R. Whitaker

62. Butter cutter. M. A. BERG. U. S. Patent 2,488,656. 1 claim. Nov. 22, 1949. Official Gaz. U. S. Pat. Office, **628,** 4: 1045. 1949.

Pats of butter are ejected from this butter cutter after they are cut by a heated blade from a block of butter stored in a chilled condition on a frame above the cutter. R. Whitaker

63. Cream sediment tester. N. C. KOTTKAMP and P. J. BAILEY (assignors to Langenkamp-Wheeler Brass Work, Inc.) U. S. Patent 2,487,248. 7 claims. Nov. 8, 1949. Official Gaz. U. S. Pat. Office, **628,** 2: 422. 1949.

A tubular tester for inserting into cans of cream, the volume of product to be tested being controlled by finger-operated air valves in the top and 2 attached float valves which open and close depending on the volume desired.

R. Whitaker

Also see abs. no. 74, 78, 79, 86, 91.

CHEESE

A. C. DAHLBERG, SECTION EDITOR

64. Rasprostrannost streptokokkovo bakteriofaga saragh. (The incidence of streptococcal bacteriophage in cheese.) E. B. RUNOW. Mikrobiologia, **8:** 174–176. 1949.

Sixty-seven Russian domestic cheese varying in age from 2–48 mo. were examined for the presence of bacteriophage. The cheese made from raw or pasteurized milk included the following types: Jaroslav, Dutch square, Dutch round, Gouda, Volga, Uglitsh, Tilsit, Soviet, Camembert, Cheddar and Swiss.

To 20–30 g. of ground cheese was added water at 45° C. in amounts to get a ratio of cheese to water of 1:2.5. The cheese-water mixture was stored in sterile containers for 18–20 hr. at 4–10° C. Cheese with acidities below the precipitation point of the protein were acidified with lactic acid. The mixture was filtered through filter paper followed by a Zeiss filter which filtrations rendered the filtrate clear in most instances. Aseptic methods were used throughout.

One-ml. portions of the various filtrates were added to 9-ml. quantities of sterile milk containing 1 loopful of streptococcus culture sensitive to bacteriophage. A control tube without added filtrate also was prepared. All tubes were held at 35° C. for 12 hr. and examined microscopically for evidence of bacterial lysis and acid development.

By giving to the amount of acid produced by the control tube an abritrary value of 100%, 14.7% of the filtrates retarded acid production by 30–40%, 8.8% by 40–50%, 16.2% by 50–60%, 30.9% by 60–70% and 29.4 by over 70%. The conclusion was reached that bacteriophage active against lactic streptococci is widely distributed among cheese and apparently is a permanent factor in the surroundings of cheese. I. Peters

65. Kyllagringsförsök med Ost (Low-temperature storage experiments with cheese.) K. E. THOMÉ, T. BERGMAN and S. HOFF. Svenska Mejeriernas Riksförening Meddelande No. 7. In yearly report Alnarp Lantbruks-Mejeri-och Trädgårsinstitut, pp. 84–144. 1948.

At the Swedish Dairies Association's Riksost cold storage plant at Växjö, about 3,500 cheeses

were used for these experiments. The types of cheese were Herrgård, Gouda and Svecia. A part of the cheese was stored at – 2° C. and part of it was stored at the normal storage temperature of 13–14° C.

The experiments were divided into 3 sections: (a) cheese stored at normal temperature, placed in storage at different ages, (b) to determine how cheese from the same lot reacts to different combinations of normal and low temperature storage, (c) intended to answer questions regarding the low-temperature technique and economy.

The usual rules (*i.e.* 1–10 points for size and shape, surface and rind, color, texture, consistency, taste and flavor) were used for grading the cheese. Six experienced judges did the grading. The degree of ripening was determined according to protein decomposition (Mogensen's method) and volatile acids present.

Nothing in the experiments pointed to any abnormal activity with regard to protein-decomposition during low-temperature storage. It was retarded, however, by the low temperature. The formation of volatile acids seemed to stop altogether during low-temperature storage and it did not restart after the storage temperature was raised. It seemed that the volatile acids formed during the production of the cheese and during the very first part of the storage period was the only volatile acid that had any effect on the grade of the cheese. The average age of the cheese suited for the experiments was between 2 and 3 mo. when placed in storage. If the cheese is stored at such an age as to be fully ripened when removed from storage, it follows that it will become over-ripe if left for any length of time at normal temperatures.

Experiments were made to determine how the cheese should be handled during storage at a low temperature. All of the cheese when first placed in storage was checked for condition of surface and rind. Re-treatment with paraffin during 6-mo. storage did not apear to be necessary if the cheese had reached a suitable age and degree of ripening. For these tests 3–4 mo.-old Herrgård and 1.5–3 mo.-old Svecia and Gouda cheese were used.

During low-temperature storage when placed separately on the shelves, normal Svecia cheese needed no turning. It was found best to turn Herrgård and Gouda cheese every month or every second month, however, to prevent the upper side from becoming sunken.

At normal temperature storage at a temperature of + 13° C., it was regarded as the best plan to turn the cheese every third day in the early part of the storage period but less often toward the end of the storage period. Paraffin treatment of cheese stored at the normal storage temperature seemed to be necessary about once a month.

Svecia cheese can be stored on edge but in order to avoid damage to the rind, the cheese should be rotated slightly at least once a week. This storage method makes better use of available space. A photograph in the bulletin illustrates how storage of cheese on edge may increase the storage capacity by about 67%.

If the cheese is stored in piles of not more than three cheese in each pile, no damage seemed to result to the cheese and the storage capacity was increased by 67%. It further was indicated that if some of the shelves that had been removed when piling the cheese 3 deep, could be assembled in the hallways, the storage capacity could be increased by 150%. Although these experiments were carried out on a small scale, the pile-storage method was adopted by the Riksost Association after the experiments were completed. It was used succesfully both for Svecia and Herrgård cheese.

The cost of storing cheese for 6 mo. at normal storage temperature compared with storing it for 6mo. at the low temperature, showed the low-temperature storage cost was 50% lower than that for normal temperature storage.

After the completion of the experiments the low-temperature storage cheese was, as a whole, of better quality than the cheese stored at the normal temperature.

Low-temperature storage seemed to improve the consistency of the cheese, but the greatest advantage in this method was in the balancing of the seasonal variations in manufacture. Next in importance was the greater utilization of storage space during the summer when storage space is in great demand. G. H. Wilster

66. Curd cutting apparatus. E. C. DAMROW (assignor to Damrow Bros. Co.) U. S. Patent 2,488,053. 3 claims. Nov. 15, 1949. Official Gaz. U. S. Pat. Office, **628,** 3: 762. 1949.

Several forking arms, pivoted to a motor and gear assembly mounted above the cheese vat, are caused to rotate. The lower ends of the arms, bent parallel to the bottom of the cheese vat, are equipped with teeth for stirring the curd.

R. Whitaker

67. Citric acid esters in cheese. C. M. GOODING, R. H. NEAL and H. W. VAHLTEICH (assignors to Best Foods Co.) U. S. Patent 2,485,637. 20 claims. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, **627,** 4: 1031. 1949.

Mono- and di-alkyl and -alkylene esters of citric acid are used as antioxidants in cheese products

comprising butterfat, non-fat milk solids and milk proteins. R. Whitaker

68. Cheese cutting machine. P. J. SCHLUDE. U. S. Patent 2,489, 504. 1 claim. Nov. 29, 1949. Official Gaz. U. S. Pat Office, **628,** 5: 1396. 1949.

A device is described for cutting cheese into small pieces suitable for wrapping for retail trade. R. Whitaker

CONDENSED AND DRIED MILKS; BY-PRODUCTS

F. J. DOAN, SECTION EDITOR

69. Skyr—Islands nasjonalrett. (Curds—Iceland's national dish.) OLAV KLOKK. Meieriposten, **38,** 30: 526–528. July, 1949.

Skyr is a nourishing, tasty food which keeps well and which can be transported unchanged, for long distances. It has been reported that if the product is stored in wooden kegs, it will remain palatable for several years. The directions for making it are as follows:

The skimmed milk must first be warmed to 90° C. and then quickly cooled to 40° C. In warm weather it is cooled to 30° C. To 200 kg. of milk, 15 g. of rennet should be added (strength of rennet was not given) and 2 l. of skyr from a former batch. When no skyr from a former batch is available to use, it may be necessary to repeat the curd-making process a few times before the desired results are obtained. The milk, with rennet added, must be kept evenly warm, 40–50° C. for 2 hr. or longer, depending upon the rennet action. The coagulated milk is poured on a strainer cloth stretched over a wooden frame. The whey is drained off and a weight of 6–8 kg. may be placed on the curd to press it. When the whey has drained off, the soft curdy mass is packed in parchment-lined wooden kegs holding 60–70 kg.

One kg. of skyr is made from 3 kg. skimmed milk. In Reykjavik, during harvest season, 1 kg. of skyr cost kr. 3.50. A liter of whole milk brought kr. 1.90 and the price for cream was kr. 14.60/l. G. H. Wilster

70. Stabilizing evaporated milk. H. E. OTTING (assignor to M and R Dietetic Laboratories, Inc.) U. S. Patent 2,490,599. 4 claims. Dec. 6, 1949. Official Gaz. U. S. Pat. Office, **629,** 1: 248. 1949.

By means of a base exchange treatment, milk is prepared having a Ca:P ratio of 0.815 to 1.155. To stabilize evaporated milk, from 8–60%, based on total solids, of the treated milk is added, prior to sterilizaiton in the range from 220–270° F. R. Whitaker

71. Milk evaporator. A. W. BAUMANN. U. S. Patent 2,485,689. 6 claims. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, **627,** 4: 1044. 1949.

The novel feature of this vacuum pan for condensing milk is the method of introducing the milk into the pan. The insert pipe passes down through the middle of the coils to within a short distance of the bottom of the pan. The end of the pipe is flanged outwardly. The milk forced between the flange and bottom of the pan flows outwardly and upwardly around the coils. R. Whitaker

72. Non-starch dessert composition. F. GATTI (assignor to G. Fabre.) U. S. Patent 2,485,043. 4 claims. Oct. 18, 1949. Official Gaz. U. S. Pat. Office, **627,** 3: 748. 1949.

A mixture of agar-agar, dextrose and $NaHCo_3$ when added to milk to form a dessert, does not curdle the milk. The amount of dextrose exceeds the agar-agar and the proportion of $NaHCo_3$ may be from 15–40/100 parts agar-agar. R. Whitaker

73. Amino acid compositions and their preparations. D. B. HAND, J. G. BRERETON and O. W. KAUFMAN (assignors to Sheffield Farms, Inc.) U. S. Patent 2,489,880. 4 claims. Nov. 29, 1949. Official Gaz. U. S. Pat. Office, **628,** 5: 1494. 1949.

Acid whey at pH 4.5 is heated to 140° F. to coagulate the proteins. The coagulated proteins, dispersed in water at pH 6.8–7.2, are digested by the proteolytic enzymes in macerated pancreas for several days at 110–115° F. The enzymes are inactivated by heat, any solid material filtered off and the soluble amino acids concentrated. R. Whitaker

DAIRY CHEMISTRY

H. H. SOMMER, SECTION EDITOR

74. Water-insoluble fatty acids and butyric acid in cream and butter. F. HILLIG, H. A. LEPPER and W. I. PATTERSON, Food and Drug Administration, FSA, Washington 25, D. C. J. Assoc. Offic. Agr. Chemists, **32,** 4: 731–735. 1949.

Cream was held for various periods of time and determinations made for titrable acidity, butyric acid, propionic acid, lactose and water-insoluble acids. Experiments show that as cream ages and decomposes, the fat may break down form-

ing water-insoluble acids. In some cases, quantities of water-insoluble acids far in excess of those normally present in sweet cream were observed. The results suggest that water separators may be one of the factors causing early decomposition of cream. Data are presented on the water-insoluble acids in 321 samples of commercial butters. Butyric acid was present in some of the butters containing the larger quantities of water-insoluble acids. Analyses on numerous cans of cream that actually were used in commercial churnings showed variations in water-insoluble acids ranging from 50 to 6000 mg./100 g. F. J. Babel

75. Detecting foreign fats in ice cream. W. H. MARTIN, W. D. RUTZ and C. H. WHITNAH, Kansas State College, Manhattan. Ice Cream Trade J., **45,** 11: 48–49, 85–88. Nov., 1949.

Reichert-Meissl, Polenske and Kirschner numbers were determined on fat extracted from ice cream and from ice cream in which 5 different vegetable fats had been substituted for one-third of the butterfat. The Reichert-Meissl number measures the volatile, soluble fatty acids of fats and oils, the Polenske number measures the insoluble, volatile fatty acids and the Kirschner number approximates the butyric acid content of the fats.

Butterfat from cows fed normal rations has a Reichert-Meissl value ranging from 24 to 33, while most other fats and oils have numbers of 1 or less. Coconut oil, with a Reichert-Meissl number of 7, is an exception. Polenske numbers of butterfat vary between 1.5 and 3 and coconut oil has a Polenske number between 16.8 and 17.8. Other fats and oils generally have values of less than 1. If ice cream contains foreign fats in addition to butterfat, the Reichert-Meissl number of the resulting mixture should be the weighted average of these fats. Data presented show that this relationship existed. W. H. Martin

76. Refractive indices of lactose solutions. F. W. ZERBAN and J. MARTIN, N. Y. Sugar Trade Lab., New York, N. Y. J. Assoc. Offic. Agr. Chemists, **32,** 4: 709–713. 1949.

The refractive indices of lactose hydrate solutions, containing up to 32% of this sugar, were determined at 20° C. to the 5th decimal place with a Bausch and Lomb precision refractometer. The results obtained agree satisfactorily with those reported by McDonald (J. Research Nat. Bur. Standards, **41:** 63. 1938). Results obtained by previous authors were compared with the more recent ones and critically discussed. F. J. Babel

77. Stabilization of standard carotene solutions. M. L. COOLEY, General Mills, Inc., Larro Research Farm Lab., Rossford, O. J. Assoc. Offic. Agr. Chemists, **32,** 4: 706–709. 1949.

Small quantities of mixed tocopherols or pure α-tocopherol in petroleum ether solutions of purified carotene provide an antioxidant effect by which carotene is preserved from deterioration for as long as 12 wk. Without tocopherols, destruction of carotene was pronounced in 2 or 3 d. To effect proper stabilization, from 10 to 50 times as much tocopherols as carotene was necessary. Use of more than 5 mg. of tocopherols/100 ml. of petroleum ether was not advisable because of the production of a measurable amount of color. F. J. Babel

78. Stabilized fats and oils. J. KORNER (assignor to Selmo Chemical Corp.) U. S. Patent, 2,486,177. 1 claim. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, **627,** 4: 1170. 1949.

Butter and other edible fats and oils are protected against oxidation by an antioxidant consisting of ammonium gallate or a substituted ammonium gallate. R. Whitaker

79. Margarine and butter composition. H. W. VAHLTEICH, R. H. NEAL and C. M. GOODING. (assignors to Best Foods Co.) U. S. Patent 2,485,634 12 claims. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, **627,** 4: 1030. 1949.

Dialkyl and dialkylene esters of citric acid are used as antioxidants for margarine and butter at the rate of 0.5–1.5%. R. Whitaker

80. Praktiska försök över ljusets inverkan på mjölkens smak under olika betingelser. (Practical experiments to determine the influence of light upon the flavor of milk under varying conditions.) HILMER DANIELSSON, Svenska Mejeritekniska Meddelande, no. **2:** 3, 8. 1947.

By covering some transparent glass milk bottles with dark-colored cardboard cartons and then leaving an equal number of milk bottles uncovered, it was possible to gain an understanding of the effect of light upon milk. All of the bottles of milk in the experiment were placed together and held at the same temperature for the same length of time. After 0.5 hr. the milk was judged and again after a 24-hr. storage period at 10° C. Milk in bottles covered with dark-colored paper cartons did not develop the oxidized or metallic flavor defect.

By treating milk with hydroquinone, it was impossible to prevent the development of the flavor defect to some extent. This was true especially when exposing milk to direct sunlight. Brown glass bottles were useful in retarding the develop-

ment of an oxidized or metallic flavor in milk. After 1 hr. of exposure to light, only a slight change was noticed in the flavor of the milk. After storing for 24 hr., milk in brown glass bottles which had been exposed to direct sunlight for 30 min. showed only a very slight change in flavor.

It is advisable to keep milk and milk products protected from light, and especially from sunlight. G. H. Wilster

81. Nonenzymatic browning of foodstuffs. Production of carbon dioxide. V. M. LEWIS, W. B. ESSELEN, JR., and C. R. FELLERS, Univ of Mass., Amherst. Ind. Eng. Chem., **41,** 11: 2587–2591. Nov., 1949.

Production of CO_2 in a variety of foodstuffs was studied by sealing the samples in pyrex tubes and analyzing the headspace gases for CO_2 after long storage periods. Many foods generated CO_2 on storage at 100° C., Cheddar cheese producing 1.14 and 1.80 mg/g. after 3 and 7 d., respectively. A study of the reaction between reducing sugars and amino acids with regard to CO_2 production showed that decarboxylation of the amino acid was an integral part of the reaction at 100° C.

B. H. Webb

82. Nonenzymatic browning of foodstuffs. Nitrogen-free carboxylic acids in the browning reaction. V. M. LEWIS, W. B. ESSELEN, JR., and C. R. FELLERS, Univ. of Mass., Amherst. Ind. Eng. Chem., **41,** 11: 2591–2594. Nov., 1949.

A reaction that produced browning of foods was found to occur between glucose and the carboxylic acids in general. The effect of pH, temperature and oxygen on the glucose-carboxylic acid reaction, particularly that involving citrates, lactates and acetates was determined. The reaction was inhibited completely by SO_2 in the absence of oxygen when the pH of the medium was low. The color produced by the carboxylic acid-glucose reaction is of the same order as that produced by the amino acid–glucose reaction. It is believed that the nitrogen free acids play an important role in the browning of foods.

B. H. Webb

83. Production of protein filaments. W. A. CALDWELL and E. R. WINTON (assignors to Imperial Chemical Industries.) U. S. Patent 2,489,-519. 8 claims. Nov. 29, 1949. Official Gaz. U. S. Pat. Office, **628,** 5: 1401. 1949.

An aqueous solution of a protein such as casein is extruded into acid saline coagulating bath and the resulting filaments stretched at a temperature of not over 40° C. in a saline solution which has no swelling effect. The stretched fibre then is passed through a hot saline solution at 40° C. or above, again causing no swelling of the filament. R. Whitaker

84. An ultraviolet spectrophotometric method for the quantitative estimation of benzene hexachloride in milk. J. P. FRAWLEY and B. DAVIDOW, Food and Drug Administration, FSA, Washington 25, D. C. J. Assoc. Offic. Agr. Chemists, **32,** 4: 758–762. 1949.

The method is based on the dehydrohalogenation of benzene hexachloride to 1,2,4-trichlorobenzene and the estimation of the latter compound by means of an ultraviolet spectrophotometer. The method is applicable to all the isomers, and is sensitive to 0.1 mg. of benzene hexachloride. As outlined, the method will quantitatively estimate 0.5 p.p.m. in milk.

F. J. Babel

Also see abs. no. 70.

DAIRY ENGINEERING

A. W. FARRALL, SECTION EDITOR

85. Elastic guide for cream separator shafts. E. C. J. JADOUL. U. S. Patent 2,488,295. 18 claims. Nov. 15, 1949. Official Gaz. U. S. Pat. Office, **628,** 3: 827. 1949.

Four rigid guides arranged equidistantly about the shaft of a cream separator are held in place by elastic members which urge the shaft to rotate without vibration in case of misbalancing.

R. Whitaker

86. Centrifuge with primary and secondary zones of separation and process therefor. I. J. LUNDAL (assignor to Sugar Creek Creamery Co. and Cherry Burrell Corp.) U. S. Patent 2,485,-209. 22 claims. Oct. 18, 1949. Official Gaz. U. S. Pat. Office, **627,** 3: 787. 1949.

This milk or cream separator bowl is designed to discharge continuously 3 components, (a) cream, (b) skimmilk and (c) precipitated protein, foreign matter, slime and other materials of high density. The product to be separated enters a pre-separating chamber, where the high density materials are discharged through a port to the outer edge of the bowl and thence through another port in the bowl wall; the cream and skimmilk, unseparated, pass through a large opening into a second chamber. The second chamber, containing cone-shaped discs, is essentially the same as the conventional cream separator and the cream and skimmilk are separated and collected in the usual manner. R. Whitaker

87. Pasteurizing and cooling apparatus. W. J. MILLER. U. S. Patent 2,489,043. 2 claims. Nov. 22, 1949. Official Gaz. U. S. Pat. Office, **628,** 4: 1147 1949.

Milk and other fluids are heated and cooled by following a spiral track through this heat exchanger which consists of horizontal disks held in place by a vertical frame. R. Whitaker

88. Governor. W. H. HARSTICK (assignor to International Harvester Co.) U. S. Patent 2,484,-995. 4 claims. Oct. 18, 1949. Official Gaz. U. S. Pat. Office, **627,** 3: 735. 1949.

This governor, designed to control the speed of a vertical, series-wound, motor-driven cream separator, depends for its action on the air pressure built up by an impellor operating in a housing on the bottom of the motor. R. Whitaker

89. Don't fool with ammonia systems. W. DAVIS, Natl. Safety Council. Operating Engineer, **2,** 10: 44–45. Oct., 1949.

Periodical maintenance of equipment and safety devices cuts the accidents. Safety valves may be tested by a simple out-of-the system method which makes use of a high pressure grease gun with proper line and gauge fittings. The piping for this set-up is illustrated. Heat exchangers eliminate the danger of slugs of ammonia returning to the compressor. When possible, stop the compressor while tightening packing glands. Packing glands should be tightened to eliminate ammonia leaks. Oil separator discharge lines should run to a closed vessel containing water. Operators have been severely burned by ammonia being discharged into open buckets or vessels.

Air in the system mixing with lubricating oil is dangerous. Never use oxygen at high pressure to test refrigeration system. Oxygen-lubricating oil mixtures may ignite without a spark. Do not tighten pipe joints until the line is free of pressure. Leaks indicate some weakness; when a nut is tightened, the bolt may break and, if the line is under high pressure, cause the joint to break. Pipe line insulation must be kept in good condition. Broken insulation may permit condensation on the pipe which in turn leads to corrosion. H. L. Mitten, Jr.

90. Milk cooler use of heat removed from milk. R. C. SHIPMAN, United Coop. Labs., Ithaca, N. Y. Agr. Eng., **30,** 11: 531–532. Nov., 1949.

A number of 4-can milk coolers were tested using procedures of the American Society of Refrigerating Engineers Standard Methods of Rating and Testing Complete Can-Type Milk Coolers.

Cooling rate curves are presented which indicate that: (1) agitation of the water bath assists materially in moving heat from can to water, (2) agitation of water bath aids in reducing temperature difference between top and bottom of can, (3) the greatest amount of heat is removed from the can during the 1st hr. in the cooler, (4) if water contacting can is 40° F. or below 1st hr., warmest part of can will be below 50° F. within 1 hr. and (5) only small can temperature differences exist in all types of coolers at end of a 12-hr. period.

Fast cooling at time of loading is dependent upon the amount of stored refrigeration and the maintenance of cooling medium temperature below 40° F. Total running time and power required/degree temperature change was very similar for all the coolers even though 3 were powered by 0.33 hp. motors and 2 by 0.25 hp. motors.

In considering the use of heat from milk to warm the milk house, it is recognized that heat is removed from milk in a shorter time in winter than in summer and that less milk is produced in winter. An additional heat load can be placed in the cooler to increase its operating time by adding water. Water should be added in such a manner as to keep the cooling water under 40° F. and not to destroy the required stored refrigeration. H. L. Mitten, Jr.

91. A low-cost mechanical cooler for holding cream. H. L. MITTEN, F. E. SATCHELL, J. J. McDOW, and A. W FARRALL, Mich. State College, E. Lansing. Agr. Eng., **30,** 11: 525–527. Nov., 1949.

A low-cost, dry-box, mechanical cooler is described. This cooler was designed, built and tested at Michigan State College. On-the-farm tests indicated that the mechanical cooler offered a positive means of maintaining cream quality at low operating costs. Drawings are presented which show dimensions, cooling oil arrangement and insulating details. H. L. Mitten, Jr.

92. Deaerating heater licks corrosion in creamery. E. W. F. FELLER, Operating Engineering, Albany 1, N. Y. Opr. Engineering, **2,** 11: 24–25. Nov., 1949.

Corrosion in heaters and condensate return lines and traps caused by dissolved oxygen and CO_2 in feedwater necessitated frequent pipe replacement in a Cal. creamery. Oxygen content of the feedwater was reduced to 20% of its former quantity by replacing the open feedwater heater with a deaerating unit. Great savings in maintenance resulted. Every ammonia receiver and evaporater in the creamery is piped to a manifold outside the plant so that any unit may

be dumped to the sewer in case of fire. The manifold valves are encased in glass.

H. L. Mitten, Jr.

93. Treat rotary pumps right. A. M. SHAW, Worthington Pump and Machinery Corp., Harrison, N. J. Operating Engineer, **2,** 11: 38–39. Nov., 1949.

Because rotary pumps are built to close clearances, they require careful handling and installation to insure long, trouble-free life.

External strains on pump casing or drive shaft may cause much damage. The pump must be carefully aligned with its driver to prevent the transmission of radial and axial thrusts to the pump and piping should be supported as near pump as possible to prevent distorting strains. The suction line piping should never be smaller than the pump opening. If thick liquids are to be handled, the suction piping may be larger than the pump opening. The suction line should be short and direct. The pump should not be run dry, for it will wear rapidly or seize. Mechanical seals must be tight. Seal faces may be reconditioned by holding the seal flat and moving its face in figure eights over fine lapping paper which is resting on a flat plate or piece of plate glass.

H. L. Mitten, Jr.

94. How lubrication licks friction. Anonymous. Power, **93,** 10: 98–99. Oct., 1949.

Friction is classified as sliding, rolling and fluid. Lubrication is a means of separating parts to eliminate sliding friction and substituting rolling friction or fluid friction. The types of friction and elementary ideas of lubrication are presented pictorially. The lubrication engineer produces lubricants to fit certain requirements. He blends mineral oils, compounds mineral oils with vegetable or animal fats to make a lubricant for various conditions of pressure, temperature and moisture.

Lubricating oils are of three types: animal, vegetable and mineral. Animal oils are generally used in compounds of animal and mineral oils. Tallow, lard oil and degras are used. Tallow is used in white greases and as a saponified base to hold lubricating oils in grease. Lard oil is used for cutting oils in lubricants and in stainless oils. Of the vegetable oils, castor oil is the best lubricant. It does not mix well with mineral oil unless another fixed oil is present.

Mineral oils are made from crude petroleum. There are several large oil-producing regions in the U. S. Pennsylvania fields produce paraffin-base crudes; mid-continent fields produce mixed-based; and western (and most foreign) fields produce asphalt-base crudes. Most lubricating oils are blended of various crude stocks available to gain a preferred group of properties.

Solid lubricants consist of graphite, talc, soapstone, flowers of sulphur, white lead and similar materials.

Refining processes are discussed.

H. L. Mitten, Jr.

95. Quick check for pipe stress, thrust. J. J. Blank. Power, **93,** 10: 87–89. Oct., 1949.

Equations, tables and curves are presented for the rapid determination of allowable pipe stress and thrust. Tables, curves and instructions are complete and can be applied without explanation. The tables are based on the principle of the "guided cantilever". Examples of application also are presented. H. L. Mitten, Jr.

96. Humidifiers—how to select and apply. T. G. HICKS, New York, N. Y. Opr. Engineering, **2,** 11: 34–35. Nov., 1949.

Before a humidifier can be chosen, it is necessary to know (1) the relative humidity desired, (2) indoor temperature desired, (3) minimum recorded outdoor temperature for plant locality and (4) the number of air changes needed/hr.

Humidifiers are classed as direct and indirect. Direct humidification is used where high humidities must be held and cooling and ventilation are not important. Indirect humidification is used for comfort air conditioning. A combination of indirect and direct is used in industrial application where cooling or ventilating loads are high. Direct humidifiers are identified as (1) atomizing, (2) high-duty, (3) spray and (4) self-contained or centrifugal. Indirect humidifiers use a heated coil to vaporize water and a fan to distribute the vapor.

An example illustrates the method of selecting a humidifier. Several drawings and a moisture-humidity curve are presented.

H. L. Mitten, Jr.

97. Careful planning produces training program that clicks. E. W. F. FELLER, Power, 330 W. 42nd St., New York, N. Y. Power, **93,** 11: 74–77. Nov., 1949.

The power plant training program of Armstrong Cork Co. is described. It provides information on how to (1) prepare a boiler for service, (2) fire with different fuels and (3) handle turbines. Its aim is to teach each operator (1) what he *must* know and (2) what he *should* know. Sound slide films in color are used. Topics covered are steam generation, feedwater treatment and operating rules for boilers. Subjects such as valve construction, flue-gas analysis

and steam accessories are taught with large posters. Each student is required to answer a 2-page folder of questions. In addition to the films and posters, operating procedures are provided for every piece of power equipment in each plant. This permits on-the-job training on specific items of equipment.

A "Leaders' Guide" is issued each power-plant foreman. It contains instructions on (1) how to handle a meeting, (2) how to set up, adjust and operate the projector and (3) what to tell the group before running the film. It is claimed that outlay for the training courses has been repaid many times in more efficient operation, suggestions for improvements and better employee relations. H. L. Mitten, Jr.

Also see abs. no. 71.

FEEDS AND FEEDING

W. A. KING, SECTION EDITOR

98. Concentrations of various constituents in blood of dairy cows during stages of terminal gestation and initial lactation. I. Effect of prepartal diet on serum tocopherols. C. E. LATSCHAR, G. H. WISE, D. B. PARRISH and J. S. HUGHES Kan. Agr. Expt. Sta., Manhattan. J. Nutrition, **38,** 4: 503–516. Aug., 1949.

The cows were fed typical barn rations, supplemented and unsupplemented. There was a gradual decline in blood serum tocopherol concentrations during the last month of gestation, which became more pronounced within a few days of parturition. Minimum concentrations occurred 2 d. *post partum,* after which there was an increase.

The additions of 0.5–1 g. of tocopherols to the prepartum diet resulted in serum concentrations of tocopherols of more than 15% greater than in control animals. Supplements of 4–10 g. daily gave an additional increase in serum tocopherols. These larger supplements, however, did not prevent the decline during the parturient period. Amounts of tocopherols in the blood serum of 1 cow which was milked throughout gestation remained fairly constant during the parturient period. R. K. Waugh

99. Determination of sugar in forage plants. J. W. THOMAS, C. G. MELIN, and L. A. MOORE, Bur. Dairy Ind., U.S.D.A., Washington, D. C. Analyt. Chem., **21,** 11: 1363–1365. Nov., 1949.

A rapid method is described for extracting forage plants, including green and dried plant materials, by mixing them 5 to 7 min. in a Waring Blendor. Carotene and sugar were extracted simultaneously from green forage materials by using a mixture of ethanol and Skellysolve in the blendor. When aqueous NaCl was added to the extract, carotene remained in the epiphase while the hypophase was used for sugar analysis. It was not necessary to clarify the extract with lead. Extraction with the Waring Blendor was as complete as with the longer A.O.A.C. method of Soxhlet extraction. H. B. Webb

Also see abs. no. 77.

GENETICS AND BREEDING

N. L. VAN DEMARK, SECTION EDITOR

100. A seminal defect associated with sterility of Guernsey bulls. J. L. HANCOCK and D. H. L. ROLLINSON. Vet. Record, **61,** 45: 742–743. 1949.

A morphological abnormality of spermatozoa found in 12 young Guernsey bulls with a breeding history of total sterility is described. Photomicrographs show an absence of intact spermatozoa, with only free heads and tails present; no sample examined had more than 5% intact spermatozoa. This characteristic feature was observed in 73 ejaculates studied from the 12 bulls, including repeated samplings for periods of 1–8 mo. Motility ratings on the semen gave low values, and microscopic examination of diluted semen at the time of collection indicated the free tails and heads already were present, with the free tails having some movement. Motility was maintained for periods of 36–116 hr. when the semen was stored at 4° C. Density values ranged from 100,000–900,000 sperms/ml. In stained slides of the separated heads and tails, the heads appear normal with a deep indentation at the point of separation, but most of the tails are abnormal. Pedigree examination of the 12 bulls indicates the abnormality is not genetic origin nor could any other common environmental factor be found. R. P. Niedermeier

101. Why cows fail to conceive when bred by artificial insemination. G. T. EASLEY, Sulphur, Okla. Vet. Med., **44,** 11: 455–459. Nov., 1949.

A general review paper gives data on the factors influencing conception (health, season, breed), factors affecting the production of normal semen (exercise, condition, frequency of use, number of ejaculates collected, age, cleaning the bull), collection and preservation of semen (semen collection, processing semen, method of insemination) and factors related to the cow (time of insemination, estrous cycle, calving interval, age, exercise, excitement, abnormal anatomical structures, infections of the reproductive and endocrine balance). B. B. Morgan

102. "Bulldog head" cattle. R. B. BECKER and P. T. DIX ARNOLD, Florida Agr. Expt. Sta. J. Heredity, **40,** 10: 282–286. Oct. 1949.

Five of the several cases of viable prognathism (bulldog head, undershot jaw) recorded in grade Jersey cattle were specifically indicated in a 5-generation pedigree. The report is illustrated by photographs of 2 prognathous cows and normal close relatives. The side and front view of the skulls of 1 affected and 1 normal cow of the same breed also are shown. Skulls in prognathous animals were visibly wider than the normal skull. The difference in the length of the frontal bones between the 2 skulls was slight, indicating the shortened prognathous skull is caused largely by shorter maxilla and premaxilla. A shortened nasal bone dimension of 3.4 in. was noted. The orbits were larger and more nearly rectangular than in the normal. Impaired vision was associated with prognathism in the herd studied. The inheritance was concluded to be that of a single autosomal recessive gene. L. O. Gilmore

103. An acardiac monster from a cow. C. W. OTTAWAY, Cambridge Univ. British Vet. J., **105,** 8: 318–320. Aug., 1949.

After artificial insemination from a Shorthorn bull, a non-pedigreed, Shorthorn cow with a history of 3 previous normal calvings, expelled a monster which was within the fetal membranes of a normal calf. The monster was a spherical mass covered with hair. It weighed 440 g. with a circumference of 35 cm. A complete anatomical description including dissection data is presented. B. B. Morgan

HERD MANAGEMENT

H. A. HERMAN, SECTION EDITOR

104. An estimate of the quarterly calving rate of heifers in Welsh counties and the percentage annual replacements in the principality. Part I. Calving rates. R. PHILLIPS, University College of Wales, Aberystwyth. British Vet. J., **105,** 9: 351–369. Sept., 1949.

After a study of returns of the quarterly rates of calving it was found that the seasonal rates of calving had shifted and that the percentage of heifers calving had increased. It was estimated that over 50% of the heifers calve during Sept. to Dec. Complete protocols are presented.

B. B. Morgan

105. An estimate of the quarterly calving rate of heifers in Welsh counties and the percentage annual replacements in the principality. Part II. Estimated herd replacements. R. PHILLIPS, University College of Wales, Aberystwyth. British Vet. J., **105,** 10: 384–392. Oct., 1949.

Further studies on returns of the quarterly rates of calving showed that in the Welsh dairying counties only 1 heifer calf is reared for every 3 cows. About 4 heifers need to be reared in order to obtain 3 of them in-calf, although most counties require 3 reared heifers to get 2 in-calf.

B. B. Morgan

106. Pulsator for milking machines. L. DINESEN (assignor to Perfection Manufacturing Corp.) U. S. Patent 2,489,563. 9 claims. Nov. 29, 1949. Official Gaz. U. S. Pat. Office, **628,** 5: 1411. 1949.

A device, operated by fluid pressure, produces pulsations suitable for a milking machine by means of 2 reciprocating pistons.

R. Whitaker

107. Milking machine time determiner. G. T. WILLSON (assignor to DeLaval Separator Co.) U. S. Patent 2,488,754. 8 claims. Nov. 22, 1949. Official Gaz. U. S. Pat. Office, **628,** 4: 1071. 1949.

The rapidity of the pulsations of a milking machine are adjustably controlled by this device which electrically operates a pneumatic valve controlling the vacuum supply. R. Whitaker

108. Milker releaser. F. G. HODSDON (assignor to International Harvester Co.) U. S. Patent 2,488,725. Official Gaz. U. S. Pat. Office, **628,** 4: 1063. 1949.

Milk is released from the reduced pressure used in milking machines, from this vessel consisting of 2 chambers operated alternately by a system of valves to continuously permit withdrawal of milk. R. Whitaker

109. Milk strainer. D. O. BRANT. U. S. Patent 2,483,000. 4 claims. Sept. 27, 1949. Official Gaz. U. S. Pat. Office, **626,** 4: 1059 1949.

This strainer is designed for use on farms for filtering freshly drawn milk into milk cans. The filtering medium is supported over the drainage outlet by several finger-like members attached to the bottom of the tapered strainer vessel. The drainage outlet consists of a tube of relatively small bore for a strainer of this type.

R. Whitaker

ICE CREAM

C. D. DAHLE, SECTION EDITOR

110. Promoting soft ice cream as a gallonage builder. Anonymous. Ice Cream Rev., 33, 4: 38, 69. Nov., 1949.

The introduction of a low butterfat (6%) ice cream served direct from the freezer by the McGrath lee Cream Co. of St. Louis, Mo:, has proved to be an effective means of increasing their total sales volume during the past year. Although the introduction of soft ice cream into their 3 company-owned stores has taken some sales away from regular ice cream, the product has also stimulated the sale of carry-out packages of regular ice cream. The net result has been an increase in total sales in 1949 as compared with 1948. The soft. ice cream now accounts for about 50% of their total volume. The product is sold under the name, "Frosty Kream" in the form of cones, sundaes or malts.

W. J. Caulfield

111. **Stabilized** ice cream mixes. A. B. STEINER and G. D. SPERRY (assignors to Kelco Co.) U. S. Patent 2,485,935. 4 claims. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, 627, 4: 1105. 1949.

Alginic **acid** is esterified by at least 40% to form a propylene glycol ester and used as a stabilizer for ice cream mix. R. Whitaker

112. Alginate ice cream stabilizing composition. A: B. STEINER (assigned to Kelco Co.) U. S. Patent 2,485,934. 6 claims. Oct. 25, 1949. Officiai Gaz. U. S. Pat. Office, 627, 4: 1105. 1949.

An ice cream stabilizer is composed of from 40–90% of a water soluble salt of a partially depolymerized, low-viscosity alginic acid.

R. Whitaker

113. Packaged sundae. F. T. **MOSER** (assigned to Limpert Bros. Inc.) U: S. Patent 2,486,194. 4 claims. Oct. 25, 1949. Official Gaz. U. S. Pat. Office, 627, 4: 1174. 1949.

Ice **cream** is filled into a paper cup in such a way as to leave a depression on the middle of the top surface into which the fruit, syrup, etc. is placed. The ice cream, surrounding the portion of topping, is in contact with the lid and prevents seepage of said topping at the edges of the **lid.**

R. Whitaker

114. Packages, prices, profits-Part Two. V. M. **RABUFFO.** Ice Cream Trade **J.,** 45, 11: **56–**57, **79–80.** Nov., 1949.

The open type cabinet can be used effectively by food chains and drug stores for departmentalizing and merchandising carry-home ice cream. Half-gallon and gallon units have proved to be an effective means of getting extra gallonage. The gallon size seems to be too large a unit for the average family unless a low temperature storage cabinet is available. Some manufacturers are experimenting with gallon units which can be broken up into an assortment of quarts and pints in different flavors. During the past year, there has been some development on the west **coast** in the factory-controlled portion as a means of securing greater dealer cooperation because he will have an assured profit and can figure his costs. "Captive markets", retail chains and food chains that make their own ice cream, are accounting for an increasing volume in many markets.

W. H. Martin

115. Frozen confection and edible container therefore. F. L. **HARRISON.** U. S. Patent 2,489,-129. 1 claim. Nov. 22, 1949. Official Gaz. U. S. Pat. Office, 628, 4: 1169. 1949.

A pastry shell is baked in the shape of a small cylinder with 1 end closed and the other flared outwardly. A plug of ice cream is suspended in the shell, 1 end resting on the bottom and the other flared outwardly and resting on the lip of the pastry shell, but not touching along the straight side. R. Whitaker

116. Ice cream cone. A. A. HEYMAN (assignor to J. Shapiro) U. S. Patent 2,487,136. 6 claims. Nov. 8, 1949. Official Gaz. U. S. Pat. Office, 628,2: 393. 1949.

An ice cream cone is described having a paper jacket held in place by ribs molded in the cone.

R. Whitaker

117. New frozen **citrus** purees from citrus fruits. E. A. BEAVENS, Bureau of Agr. and Ind. Chem., Pasadena, Cal. Ice Cream Rev., 33, 3: 110,112, 114. Oct., 1949.

Methods of preparation, packaging and freezing have been developed for the preparation of citrus purees which are well adapted for use in the ice cream and other food industries. Sound mature fruit is washed, stemmed, trimmed and crushed. The crushed fruit is reduced to a puree by a mechanically driven screening device with air incorporation kept at a minimum. The yield of puree is 50–60% of the whole fruit and it contains 0.65–0.75% of peel oil. Five parts of puree are mixed with I part sugar in a stainless steel tank. The sweetened puree is placed in lacquered or enameled cans of from 1–2.5 gal. capacity. The

cans either are sealed hermetically or closed with slip top covers and the contents frozen rapidly and stored at 0 to −10° F. These purees have been held for more than a year without change in flavor, color and with little or no loss of vitamin C.

Although citrus purees have been used successfully in the preparation of both sherbets and ices, better results were obtained when they were used in sherbets than in water ices. A sherbet mix containing 2.5% fat, 2.5% serum solids, 25% sugar and a suitable stabilizer gave good results with the citrus purees. In the preparation of orange sherbet 15–18 oz. of the 5:1 puree and 1.5 oz. of the 50% citric acid solution/gal. of mix proved satisfactory. When making a lemon sherbet it was found desirable to use only 10–14 oz. of the puree and 0.5 oz. of citric acid/gal. of sherbet mix. W. J. Caulfield

118. Ice cream freezer. L. H. KNIBB. U. S. Patent 2,488,668. 8 claims. Nov. 22, 1949. Official Gaz. U. S. Pat. Office, **628,** 4: 1048. 1949.

A small freezer for insertion in the freezing compartment of a domestic refrigerator, consists of 2 motor-driven scrapers rotating in a cylindrical vessel. R. Whitaker

119. Refrigeration cabinet having ice cream can support means. H. W. CUSTER. U. S. Patent 2,483,264. 1 claim. Sept. 27, 1949. Official Gaz. U. S. Pat. Office, **626,** 4: 1124. 1949.

To facilitate dispensing dipped ice cream, this cabinet is so designed that the cans are held at about a 45° angle. R.Whitaker

120. Clamp for holding spaced ice cream cans. E. S. CURTIS. U. S. Patent 4,483,038. 6 claims. Sept. 27, 1949. Official Gaz. U. S. Pat. Office, **626,** 4: 1069. 1949.

A clamp is described which easily and quickly clamps on the top edge of roundbulk ice cream cans in refrigerated cabinets and holds them rigidly to facilitate scooping of the ice cream. R. Whitaker

Also see abs. no. 75.

MILK AND CREAM

P. H. TRACY, SECTION EDITOR

121. Operational studies of home milk pasteurizers. R. C. THOMAS, Pub. Health Service, Cincinnati, O. Pub. Health Repts., **64,** 45: 1411–1422. Nov. 11, 1949.

The efficiency of 4 home milk pasteurizers was studied by the author. When the units were used according to the manufacturers' directions the phosphatase test of the main body of milk after pasteurization was negative; however, in 3 units positive phosphatase tests sometimes were obtained on the milk swabbed from the inner surface of the container just above the milk level. This was not true in the case of an "in-the-bottle" unit. Two solutions suggested by the author to prevent such positive phosphatase reactions were (a) devise the inner container so that it is completely surrounded by the heating medium and (b) insure that the milk surface and the air above will reach the proper temperature by using higher temperatures throughout the pasteurizing procedure. The double boiler method of heating the milk for 10 min. over vigorously boiling water was found to be satisfactory for heating milk in the home to make it safe for consumption, since no positive phosphatase tests were obtained. However, the temperature of the milk could not be controlled as well and the milk sometimes had a slightly cooked flavor with some precipitation of milk solids. Since the author completed his study, manufacturers of 2 of these units have altered the construction of the tops of the units so that the air temperature above the milk will be raised in hopes of inactivating the phosphatase in the milk swabbed from the inner surface above the milk level. D. D. Deane

Also see abs. no. 80, 86, 109.

MILK SECRETION

V. R. SMITH, SECTION EDITOR

122. Observations on a reflex controlling milk flow in the individual mammary gland of the cow. E. R. COCHRANE, Tresden, Highworth, Wilts, England. British Vet. J., **105,** 8: 320–321. Aug., 1949.

Studies were made on the front teat of a Shorthorn heifer which was injured by a cut through the sinus wall. This injury allowed milk to flow without going through the papillary duct. Only a few drops of milk could be removed unless the udder was stimulated, after which the gland milked itself. The flow of milk could be stopped by touching the teat. Over 30 sec. were required before the milk flow resumed. It was concluded that contraction of smooth muscle at the base of the teat closed the duct between the gland and teat sinuses. This contraction probably occurs often on injured teats. B. B. Morgan

NUTRITIVE VALUE OF DAIRY PRODUCTS

R. JENNESS, SECTION EDITOR

123. The growth-promoting effect on the rat of summer butter and other fats. S. LASSEN and E. K. BACON, Van Camp Labs., Terminal Island, Cal. J. Nutrition, **39,** 1: 83–91. Sept., 1949.

The growth-promoting properties of summer butter, margarine fat, cottonseed oil and olive oil were studied by adding them to a fat-free basal diet at levels of 10% and feeding to growing rats. Body weight changes and body length measurements were the criteria used for comparisons. Summer butter contains no growth factors not contained in margarine fat and cottonseed oils.
R. K. Waugh

124. Process for improving the digestibility of milk. O. E. CARMEN. U. S. Patent 2,490,015. 5 claims. Dec. 6, 1949. Official Gaz. U. S. Pat. Office, **629,** 1: 95. 1949.

Following milking, cows milk is cooled to 40–65° F. and then subjected to agitation by means of a beater which rotates at a speed of 1200–3000 rpm and vibrates at a frequency of from 200–400 osc./sec. for a period of time of 10–30 min. The agitation described partially removes the adsorbed layer from the fat globules, but is not so drastic as to cause rancidity. R. Whitaker

PHYSIOLOGY AND ENDOCRINOLOGY

R. R. REECE, SECTION EDITOR

125. Relation of food intake to growth depressing action of natural and artificial estrogens. J. MEITES, Michigan State College, East Lansing. Am. J. Physiol., **159:** 281–286. Nov., 1949.

The administration of either natural or artificial estrogens can depress growth in rats and mice. Of even greater interest to dairymen is that giving synthetic estrogens to milking goats can depress lactation. How these phenomena are elicited are unknown and the author has shown, by studying growing rats, that growth depression caused by synthetic estrogen administration is mediated chiefly through a resulting lowered food intake. Natural estrogens depressed growth but not by lowered food consumption. Other possible mechanisms of growth depression by administration of natural estrogens are reviewed.
V. Hurst

126. Influence of desoxycorticosterone acetate on liver and muscle glycogen of adrenalectomized animals. A. SASS-KORTSÁK, F. C. WANG and F. VERZÁR, Univ. of Basel, Switzerland. Am. J. Physiol., **159,** 2: 256–262. Nov., 1949.

Male rats (70–160 g.) were placed on 3 diets: carbohydrate rich, forced fed glucose to starved animals and protein diet. In each group, normal animals were compared on the basis of liver and muscle glycogen to untreated adrenalectomized animals and to adrenalectomized animals receiving desoxycorticosterone acetate (DCA). Animals were sacrificed at intervals varying from 2–28 d. following adrenalectomy. DCA was able to maintain normal muscle and liver glycogen in adrenalectomized animals and its action here helps to substantiate the claim that, given sufficient time to act, DCA, as well as the 11-oxycorticosteroids, can influence carbohydrate metabolism.
V. Hurst

127. Comparisons between glycogenetic property of desoxycorticosterone, 11 dehydro-17-hydroxycorticosterone (Compound E), and adrenal cortical extract. F. C. WANG and F. VERZÁR, Univ. of Basel, Switzerland. Am. J. Physiol., **159,** 2: 263–268. Nov., 1949.

These hormones were tested for their action on liver and muscle glycogen formation in adrenalectomized rats on a protein diet. Compound E caused a quicker and more powerful action on glycogen formation in a short time period, 6–48 hr., than did DCA, but over longer periods of from 7–15 d., the action of DCA became more evident. The difference in influence on glycogen formation, although still in favor of compound E, assumed a smaller magnitude over the longer time periods.
V. Hurst

SANITATION AND CLEANSING

K. G. WECKEL, SECTION EDITOR

128. A line of houseflies resistant to methoxychlor. G. W. BARBER and J. B. SCHMITT, Rutgers Univ., New Brunswick, N. J. J. Econ. Entomol., **42,** 5: 484–485. Oct., 1949.

This is a report of further studies of a type published previously and referred to herein. Under the conditions of these laboratory tests, there was 100% kill of 2 laboratory strains of flies with DDT, whereas 1 of these strains similarly succumbed to methoxychlor, but the other did not. A so-called DDT-resistant strain of flies from nature, which had been reared in the laboratory for the tests, showed resistance to both DDT and methoxychlor. E. H. Fisher

129. Reaction of certain fly strains to DDT and methoxychlor deposits. E. J. HANSENS, Rutgers Univ., and A. H. GODDIN, E. I. du Pont de Nemours & Co., Inc. J. Econ Entomol., **42,** 5: 843–844. Oct., 1949.

Laboratory insecticidal tests were conducted with flies of 3 laboratory strains and 1 so-called DDT-resistant strain from nature which had been reared to 18th and 19th generations in the laboratory. Plywood panels were treated with either wettable powder slurries or acetone solutions of either DDT or methoxychlor at several deposit rates. When deposits dried, flies were caged over specific areas for 15 min., after which knockdown and mortality records were made. Kill was judged 1 d. after exposure.

About 2.5 mg. DDT (as wettable powder)/ft.^{2} was required to kill 100% of the 3 laboratory strains, and about 15 times more DDT was needed with the resistant strain. Methoxychlor (as wettable powder) was used at 4.7, 7.2, 7.4 and 6.2 mg./ft.^{2} to secure 100% kill of the 3 laboratory and the DDT-resistant strains, respectively.

In acetone solution, 144 mg. DDT/ft.^{2} killed 100% of the 3 laboratory strains and 25% of the resistant strain. Deposits as great as 576 mg. methoxychlor (in acetone solution)/ft.^{2} failed to kill 100% of any fly strain. E. H. Fisher

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