HYGIENIC ASPECTS OF MILK AND PAYMENT FOR QUALITY[1]

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Each of the characteristics that denotes quality in milk may be influenced by the hygienic or sanitary practices used in the production, processing and distribution of milk. Furthermore, each bears a relationship to either the presence or growth of microorganisms in milk.

Maintenance of the consumer's high regard for milk is essential. High standards of cleanliness within the industry will minimize the hazard of disease transmission through milk and will enhance its esthetic attractiveness. Milk of high sanitary quality and of unimpaired nutritive value will tend to encourage consumption and thereby be to the best interest of the consumer and to the dairy industry as well.

The availability of high quality milk supplies will depend largely upon the operation of effective sanitary control programs. Essential elements of such programs are (a) standards or requirements which must be satisfied, (b) enforcement, (c) education, and (d) compulsory pasteurization. Likewise, proper knowledge of the sources of microorganisms in milk and their control as well as the effect of other milk handling practices, such as developments in refrigeration and transportation, on milk quality are necessary.

Some distinction may be made between the bacteriological quality of raw milk as an indicator of sanitary practices used in its production, and bacteriological quality as an indicator of the suitability of milk for processing. It is clear, however, that production of milk of high sanitary quality and which is suitable for any use can best be accomplished by the application of good sanitary practices throughout all stages of production and transport to point of processing.

Important in the procurement of quality milk is an incentive on the part of producers to produce such milk. A meaningful standard of quality should be set, compliance with which is indicative of significant accomplishment. Recognition of achievement in some tangible form and large enough to be worthwhile must be provided to those who qualify.

Desire for volume of milk on the part of processor, cooperative or independent, at the expense of quality is certain to be a demoralizing influence on the operation of incentive programs.

Consumers have great confidence in the wholesomeness of milk. In this regard, it enjoys an enviable position among food products. There is good reason for this. In the first place, probably no food product is subjected to greater surveillance by government regulatory agencies whose primary responsibility is to protect the public health. This has occurred through recognition of the fact that milk improperly handled provides a ready medium for the transmission of disease. In many areas, milk, like water, is almost a universal beverage and is consumed by almost every person in some form almost every day. Furthermore, a great many people may be served by a single supply. Consequently, a contaminated supply may endanger the health of a great many individuals. Milkborne disease epidemics of the past stand as monuments ever remindful of the probable consequence of inadequate sanitary control of milk supplies. The dairy industry and government regulatory agencies recognize joint responsibility in providing safe milk. The many excellent and safe milk supplies available to consumers attest to the manner in which this responsibility is met.

It is widely recognized that of all foods, none is more important to the health of the individual than milk. This is evident from the numerous dietary patterns recommended by various government agencies and nutrition councils. In these dietary patterns, milk is prominent as an item which is recommended for inclusion in the diet of individuals of all ages.

It is extremely important, therefore, that high quality milk supplies readily be available. Anything that might happen to milk which would result in its being less desirable to consume, such as an unfavorable appearance, an objectionable flavor, or a lack of confidence in its public health safety, will tend to discourage consumption. This would not be in the best interest of the public. High standards of cleanliness within the industry will minimize the hazard of disease transmission through milk and will enhance its esthetic attractiveness. Milk of high sanitary quality and of unimpaired nutritive value will tend to encourage consumption and thereby be to the best interests of the consumer and to the dairy industry as well.

ESSENTIAL ELEMENTS OF EFFECTIVE SANITARY CONTROL OF MILK SUPPLIES

Perhaps at this point it would be well to consider those elements which are essential to effective sanitary milk control. Consideration of these is germane to any discussion dealing with the broader aspects of milk sanitation.

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Standards

The first essential is the establishment of standards—the requirements which must be satisfied in prducing, processing and distributing milk. These relate to *(a)* cows, their care and management; *(b)* use and construction of physical facilities; *(c)* milking methods; *(d)* handling and processing methods, including equipment construction, use and cleanliness; and *(e)* distribution practices. Standards should be reasonable of attainment and be related to milk quality. Past experience has shown that sanitary standards or regulations often have been used as economic trade barriers to the free movement of high quality milk supplies from one location to another. Thus, such standards, under the guise of serving to protect the public health, have served primarily to maintain exclusive markets for those producers and distributors which are located in close proximity to the city or urban area of consumption. Unnecessary requirements increase costs of production and processing. The net result ultimately is reflected in higher cost of milk to the consumer. A brief glance into the history of regulatory control of milk supplies in the United States provides ample evidence of the occurrence of such practices.

The establishment of milk ordinances in the United States began at about the turn of the century in recognition of the role that milk may play in the spread of disease. Also, it is interesting that one of the major objectives of the early ordinances was to control adulteration of milk by adding water.

The scope of milk regulation by municipalities and state governments expanded rapidly. Many principal features of early ordinances were copied by other municipalities and states, but generally, each new ordinance included special requirements applicable to the particular area involved. This resulted in the creation of a large number of laws and regulations governing the dairy industry and in requirements that differed from one jurisdiction to another. Certain clauses that appeared in ordinances were restrictive; they became effective trade barriers masquerading under the guise of public health safeguards. Thus, numerous standards of quality were established, some of which had little or no relationship to quality and frequently were costly and confusing to the public producers and processors as well.

The situation today, however, is vastly different, largely because of early recognition of the problems which inevitably would be created by overlapping authority and the lack of uniformity in the structure and application of sanitary milk regulations. Particularly significant in this regard was the publication, in 1924, by the U. S. Public Health Service of the first edition of a milk ordinance covering items of milk sanitation on farms and in processing plants. States and municipalities were urged to adopt this ordinance in the interest of providing a more uniform system of effective milk control. The recognition of this ordinance, now known as the Milk Ordinance and Code *(5)*, has steadily increased and today it has been adopted by many states and municipalities.

More recently a voluntary cooperative State-Federal program for certification of interstate milk shippers *(6)* was developed. Through this program, uniform administrative practices have led to the development of a high degree of reciprocity between states on acceptance of inspection and laboratory results.

Coupled with the above has been the development of standards for the sanitary design of milk production and processing equipment. These are known as 3-A Sanitary Standards for Dairy Equipment *(3)*, the "3-A" being symbolic of the three organizations that formulate these standards.[2] Wide acceptance by regulation agencies and by industry of equipment bearing the 3-A symbol has been achieved. This has greatly reduced the number of dissimilar design specifications required by regulatory agencies throughout the country.

The most recent effort toward uniformity has been the development of a system of certifying milk laboratories. This is coordinated by the U. S. Public Health Service through the individual state milk sanitation control authorities. Periodic surveys of laboratories and personnel concerned with bacteriological and chemical analyses are made and deviations from standard methods are noted and corrected.

While the above efforts have led to greater uniformity in sanitary milk control regulatory practices, we still have a few areas which recognize no reciprocity; hence, major impediments to interstate and even intrastate milk shipment still exist through the imposition or arbitrary and unrealistic sanitary requirements which cannot be justified on the grounds of providing protection to the public health. There is need elsewhere in this world too, I am sure, for realistic appraisal of requirements which are imposed or may be proposed in the avowed interest of providing a sanitary or hygienic milk supply.

[2]The 3-A Sanitary Standards are formulated by the 3-A Sanitary Standards Committees which consist of the following: *(a)* The Committee on Sanitary Procedure of the International Association of Milk and Food Sanitarians; *(b)* The Sanitary Standards Sub-Committee of the Dairy Industry Committee—representing dairy trade associations; and *(c)* Representation from the Milk and Food Program, Division of Environmental Engineering and Food Protection, Public Health Service, U. S. Department of Health, Education and Welfare.

Enforcement

The second essential in an effective milk control program is enforcement. Standards are meaningless without their enforcement. This may be accomplished in several ways. Permits or licenses previously granted to producers or processors may be suspended or revoked for non-compliance with standards. Degrading or revoking the privilege of using a grade label denoting a certain level of quality may be resorted to. This might, in the case of raw milk, place the milk in a lower price category; or, in the case of pasteurized or final consumer products, necessitate a change of label by the processor to that of a lower grade. Consumers react quickly in their refusal to accept milk bearing the label of a lower grade. This creates economic pressure and is an effective enforcement prcedure, although it may drastically impair the business of the violator. Prosecution under penalty clauses of statutes or ordinances is another effective means of enforcement which may be used in instances of non-compliance with standards.

A long standing principle of good public health milk control practice is that the bulk of enforcement work should be done at the municipal or local level of government. This is based on the premise that control then will be done by those who have the greatest interest in providing good quality milk to the community and who can provide direct supervision over milk production and processing. It appears that in many areas there is need for reevaluation of this premise. Today milk may be produced within a relatively small geographic area and be processed in a single large processing plant. Its distribution, however, may cover the area of a whole state, province or other major geographic area. Economies borne of large centralized processing have eliminated many small or local milk processing plants. The traversing of jurisdictional boundaries inevitably involves milk control agencies at higher governmental levels (county, state or provincial) than those of villages or cities. For this reason there is need for strengthening such agencies and for eliminating needless overlapping local jurisdictions. The pioneering efforts of cities in the development of sanitary control of milk supplies should be recognized, but steadfast adherence to the principle that municipal or local control is inviolate is not consistent with today's system of milk production, processing and distribution in many areas.

Education

The third principle of effective milk control is education. Education must be directed at producers, processors and consumers alike. Consumers must be well enough informed so that their demands are in keeping with what can be supplied. Consumers have the right to expect milk of such quality as can reasonably be attained. The industry should be fully knowledgeable relative to the methods of providing a sanitary and safe product and they should be given the reasons for various requirements imposed upon them.

Compulsory pasteurization

The fourth principle of effective milk control is compulsory pasteurization. The assumption that raw milk of low bacterial count and from tuberculosis and brucellosis accredited herds is necessarily safe milk cannot be justified. Likewise, reliance on environmental conditions designed to prevent all possible contamination of raw milk with pathogens as a means of providing safe milk is not economically feasible even if possible. Pasteurization plus the application of rigid control over the sanitary handling of milk and pasteurization must be provided if safe milk supplies are to be assured.

THE MEANING OF QUALITY

The term "quality" in reference to milk has been described or defined in many ways. Perhaps Dahlberg *et al. (1)* have best indicated the attributes or characteristics which denote quality in milk as follows: freedom from disease-producing bacteria and toxic substances; freedom from foreign material; low bacterial count; good flavor; satisfactory keeping quality; and high nutritive value. Obviously the attainment (in the literal sense) of each of these attributes would be somewhat less than complete. Nevertheless, most would agree that every reasonable effort should be made to attain them. It is also evident that each of the above attributes may be influenced, in greater or lesser degree, by the hygienic or sanitary practices used in the production of milk and during its processing and distribution as well. Furthermore, each bears a relationship to either the presence or the growth of microorganisms in milk.

FACTORS AFFECTING THE BACTERIOLOGICAL QUALITY OF MILK

Since the bacteriological quality of milk is so closely related to the overall quality of milk, the sources of microorganisms in milk and the influence of certain handling practices on bacteriological quality of milk deserve mention at this point.

Sources of microorganisms in milk

Interior of the udder. With rare exception, milk drawn aseptically from a healthy udder will contain bacteria. On exclusion of the first ounce or two of milk drawn, the microflora generally will consist of species of *Micrococcus, Streptococcus* and *Coryne-*

bacterium. The total number present will be low, usually ranging from 100-1000 per milliliter but occasionally exceeding these limits. The presence of disease in the cow and particularly udder infections, of course, may serve to greatly alter the bacterial flora qualitatively or quantitatively.

The "normal" udder microflora generally is less active in respect to growth or reproduction and metabolic activity than are organisms which subsequently gain access to milk. Furthermore, their activity is markedly retarded as temperature is lowered; their growth practically ceases at 45°F (7°C) or below.

The exterior of the animal. The surface of the animal represents an abundant reservoir from which microorganisms may gain access to milk. The surfaces of the udder and teats and the rear quarters of the animal particularly are significant in this regard. Organisms of enteric origin, i.e. enterococci and coliforms; gram negative rods of soil and water origin; sporeformers; and molds are common contaminants from this general source. Psychrophilic species among the gram negative types may be especially significant in areas where rather extensive periods of low temperature storage of raw milk occur. Likewise, certain anaerobic sporeformers important in gassy defects of cheese may be found abundantly in the barn environment where silage is fed. These may find their way to the surface of the udder and teats, into the air or to milking equipment and thence into milk. In some areas this has led to a ban on the feeding of silage to cows whose milk is used in making Swiss and other types of cheese. Thus, the numbers of microorganisms likely to be contributed from the exterior surfaces of the cow may be important quantitatively and qualitatively.

Cleanliness of the animal will reduce the numbers from this source to well below 1000 per milliliter, especially if the animals are housed and milked in a barn or area which is kept free of accumulations of manure and soiled bedding. Contamination from this source may be greatly reduced through machine milking, providing the udder and teat surfaces are effectively cleaned. With hand milking, cleanliness of the udder and flanks is perhaps even more important; also, smalltop milk pails and avoidance of "wet hand" milking are effective control measures.

The atmosphere or air. This is the third general source of microorganisms in milk. Brushing or feeding of animals just prior to milking may result in air laden with diverse types of microorganisms. Even under extremely dusty conditions, the total number contributed per milliliter of milk will be only a few (less than 50); however, they are likely to be the more resistant forms such as sporeformers, micrococci and mold spores. These are better able to withstand drying without harm and ot predominate in dried material dispersed in the atmosphere.

Milking equipment. The most important source of microorganisms in milk is the equipment used for milking and subsequent handling of milk prior to distribution or processing. Milk residues left on milk contact surfaces through failure to adequately clean and sanitize them provide a source of readily available nutrients to support microbial growth. Such equipment, when wet and during storage at moderate temperatures, will permit the development of great numbers of various types. Subsequent use of such equipment may be responsible for the presence of hundreds of thousands of bacteria per milliliter of milk. Thorough cleaning of equipment after each use is the only means for effective control of this most important source. The development and almost universal availability of good cleaning chemicals greatly facilitates the ease of accomplishing this.

Milk handling personnel. Personnel involved in the production and handling of milk may contribute to the microflora of milk. Total numbers of microorganisms contributed usually will be small but human pathogens may be among them. Raw milk available for consumption may serve as a vehicle for the transmission of several diseases, especially enteric and respiratory types. Pasteurization provides an effective safeguard; however, in much of the world, raw milk still is consumed in large quantities.

Milk handling personnel are important is another respect. One or more such individuals directly affect the extent to which the other sources of microorganisms in milk are controlled. The level of microbial population in milk will be dependent largely on the extent to which the efforts of personnel will contribute to clean cows in a clean milking environment and to the use of clean milk handling equipment and methods.

In view of the mechanisms available for the control of the above sources, no hardship is attendant to the production of milk with an initial bacterial count of only a few thousand per milliliter as measured by agar plate methods. This is evident by the examination of records of producers in numerous markets. It is not uncommon to find fifty percent of the producers consistently producing milk below 10,000 per milliliter and ninety percent or more below 50,000 per milliliter.

Influence of cooling practices

If milk must be held for any appreciable time before processing or consumption, refrigeration is the only acceptable means available for controlling the growth of microorganisms therein. For many years, milk production and handling procedures have made

extensive use of mechanical refrigeration. The relatively recent advent and now extensive use of the refrigerated farm bulk milk tank has constituted a major advance in this regard. Their use makes it possible to cool milk rapidly to well below 40°F (4.4°C) immediately after production and to hold it at that temperature as long as desired. Bacterial growth is effectively prevented. Every other day pickup of milk from farms is possible, thus effecting economy of procurement. Stainless steel tanks mounted on trucks which transport milk from farm to plant and from plant to plant are constructed in such manner so as to prevent milk from increasing in temperature more than two or three degrees during a period of 24 hours. Consequently, movement of milk over long distances without impairment of quality is possible and is commonplace in many areas.

Effective refrigeration coupled with the use of equipment of sanitary design and the advances which have been made in materials and methods for cleaning and sanitizing milk handling equipment make possible the production and maintenance of milk of high bacteriological quality with relative ease. However, all is not well in this regard. Producers, and others as well, have become accustomed to measure the sanitary quality of milk largely in terms of standards based upon bacterial counts of milk or the bacterial activity therein. Generally such standards as were established were commensurate or in accordance with what reasonably could be attained. It might be expected that as advances took place in refrigeration, sanitary design of equipment and in cleaning materials and methods, there would be an accompanying lowering of acceptable bacterial count limits. This has occurred but not to the extent that might logically be expected if we are sincere in professing our belief that milk should be produced and handled in a sanitary manner. Unfortunately, effective cooling may mask insanitary practices. Bacteriological standards commonly in effect may be me with little or only sporadic attention being given to good sanitary practices. A simple illustration may be cited. Each year my class in Dairy Microbiology conducts a simple exercise consisting of adding 500 milliliters of sterile water to each of two 10-gallon milk cans, one properly cleaned and the other improperly cleaned but both held at room temperature for 12 hours prior to the addition of the sterile water. Invariably, approximately 100-150 bacterial colonies appear on agar plates prepared from a 10^5 dilution of the rinse water in the improperly cleaned can. Less than 10 appear on plates prepared from a direct plating of 1 milliliter of rinse water from the clean can. Assuming the number of colonies from the unclean can was 100, this would indicate the presence of 5 billion per can ($100 \times 10^5 \times 500$). Assuming the volume of the can to be 40 liters (approximately 10 gallons) and that this amount of milk was added to such a can, the resulting count of the milk would be 125,000 per milliliter (5 billion $\div$ 40,000) even if the milk added were sterile! Yet, this milk would be considered to be of acceptable sanitary quality if measured by many existing standards based upon bacterial activity or count limits. Obviously, any bacteriological standard which would not discriminate against milk handling practices exemplified by the above cannot be considered realistic.

BACTERIOLOGICAL QUALITY OF RAW MILK IN RELATION TO ITS UTILIZATION

A distinction may be drawn between the bacteriological quality of raw milk an an indicator of sanitary practices used in its production and the bacteriological quality as an indicator of the suitability of milk for processing.

The number of bacteria required to alter raw milk detectably is considerably greater than the number which might indicate insanitary production practices. The early work of Hammer and Hix *(3)* and others has shown that the growth of pure cultures of various bacteria may reach levels ranging from approximately one or two million to several hundreds of millions per milliliter before any change in milk may be detected by flavor, chemical or physical examinations. Variations are affected by several factors including type of organism, temperature of growth and availability of oxygen. Recent studies in our laboratories *(4)* using pure cultures of psychrophilic types have shown that even with the most active types, approximately 2 to 10 million per milliliter must develop from an initial population of a few hundred before physical or flavor change may be detected in milk.

It is not uncommon to find bacterial counts considerably in excess of 5 to 20 million per milliliter in raw milk supplies from individual producers without observing any detectable defect. It is difficult, if not impossible, to know whether the presence of such numbers is the result of growth originating from a *few bacterial cells* or is the result of a massive inoculum from unclean equipment used in handling the milk. In the first instance, it might be expected that if active, defect-producing species grow to a level of a few million, an undesirable change may occur. In the second instance, rapid cooling of milk with *high initial populations* present would result in such populations remaining dormant; and millions of undesirable organisms may be present without detectable change occurring, provided that low temperature is maintained.

Viewed solely from the standpoint of the probability of deleterious change likely to occur in raw milk, there is little justification for bacterial count limits less than one or two million per milliliter. Even such population levels would seem to provide sufficient safety factor from that standpoint. There are other factors to consider, however. Previous discussion has emphasized the relationship between bacteriological quality and sanitary production practices. Bacterial count limits must be relatively low to be of significance in this regard.

Of major importance also are the types of microorganisms rather than mere numbers that might be present. Excessive numbers of thermodurics, coliforms and certain sporeforming types in raw milk may have significant effects on the quality of final or finished products.

The shelf life or keeping quality of properly refrigerated pasteurized milk (below 45°F or 7°C) is not materially affected by thermoduric bacteria; however, certain of the thermodurics are quite capable of altering milk held above this temperature. Pasteurized milk may not always be kept properly refrigerated, for example, in wholesale or retail outlets and in the home. The importance of excessive numbers of thermoduric bacteria in raw milk supplies thus assumes some importance.

The problems arising from the presence of an excessive number of coliform bacteria in milk used in the manufacture of raw milk cheese, particularly Cheddar cheese, are well known. The common practice in many areas of applying sub-pasteurization heat treatments to cheese milk is done primarily for the purpose of reducing the coliform population to tolerable levels, thus minimizing the occurrence of gassy defects as well as flavor defects caused by other bacterial types of similar heat resistance.

The method of manufacture of much of the volume of nonfat milk solids is dependent upon the manner of utimate use of this product. For example, nonfat milk solids containing excessive numbers of sporeformers is discriminated against by purchasers of this product for use in preparation of baby foods and other canned and sterilized products. With excessive numbers present in raw milk, normal heat processing treatments given to such products may not be sufficient to attain sterility. Consequently, excessive numbers in raw milk supplies may contribute significantly to spoilage of the finished product. Furthermore, excessive numbers of sporeformers may be traced to their "build-up" during long periods of plant operation. Likewise, certain sporeformers important in the "bitty" defect of pasteurized or "sterilized" milk are more likely to be troublesome if raw milk supplies contain large numbers of them. Also, as was mentioned previously, certain silage anaerobes if present in excessive number may cause serious gassy and flavor defects of Swiss type cheese.

More recently the presence of excessive numbers of staphylococci in cheese milk has received attention as a result of several extensive outbreaks of food poisoning traced to cheese. Studies have shown that mild heat treatments sufficient to reduce the staphylococcal population to a few per milliliter or less will result in little or no danger of their increasing to significant number during cheese making. Just what minimum level in milk for *raw milk cheese* is necessary to avoid possible build-up to hazardous levels is not clear.

It seems evident, therefore, that some distinction must be made between the bacteriological quality of raw milk as an indicator of sanitary practices used in its production, and bacteriological quality as an indicator of the suitability of milk for processing. The sharpness of this distinction, however, is clouded on the one hand by the relative importance of various sources of microorgansms in contributing certain undesirable specific types as well as gross numbers; and on the other hand by the effectiveness of modern cooling facilities in masking insanitary production and handling practices. It is clear, however, that the production of milk of high sanitary quality suitable for any use can best be accomplished by the application of good sanitary practices throughout all stages of production and transport to point of processing.

INCENTIVE FOR QUALITY

Perhaps one of the most important adjuncts to the procurement of quality milk is providing producers with an incentive to produce such milk. Where this has been done, the response has been dramatic. It is human nature to strive for a goal which promises a reward on its attainment. Incentive programs must be carefully organized. First consideration should be given to the establishment of a meaningful standard, compliance with which is indicative of significant accomplishment. Next, consideration should be given to what form of recognition should be given to those who qualify. Several possibilities may be suggested. Perhaps the most common form is the payment of an additional amount of money per unit weight of milk for meeting the standards imposed.

What should be the amount of the incentive payment? It must be large enough to be worthwhile of achievement. Generally, such payments range from 2.5 to 10 per cent of the average price per weight or volume of milk delivered. In the case of cooperative producer associations, a fixed amount of money

is available for distribution to member producers after necessary expenses have been deducted from gross receipts. Suppose this amounts to an average of $4.00 per hundredweight of milk for each producer. Using a differential of 5% the incentive payment would be 20 cents per hundredweight. If 50% of the producers involved qualified and 50% did not qualify, one-half of them would receive $4.10 per hundred and the other half $3.90 per hundred. For a producer whose production averages 200 gallons per day (approximately 1700 pounds) his return would be $3.40 per day in excess of that available to him if he did not qualify. In a month's time this would amount to approximately $100. There are few producers who would ignore the opportunity to increase their return by this amount or an amount of the same relative magnitude under a different price structure.

The question of what is meant by a meaningful standard arises. This will be dependent upon the general quality level which producers are capable of attaining. Obviously the amount of educational assistance which has been provided, the type of facilities possessed by producers, and their level of understanding of sanitary production methods will determine in large measure the standard to be imposed. For example, in one well developed area where milk is produced primarily for fluid consumption, a bacterial count standard of 50,000 per milliliter was established by the largest producer cooperative (approximately 2500 producers) supplying this market. The regulatory standard in existence was 200,000 per milliliter. Thus, the standard for incentive payment was set well below that required by the municipal regulatory agency. All producers recently had acquired refrigerated farm bulk tanks. The situation attendant to rapid and effective cooling facilities, whereby insanitary practices may be masked, developed. This was a major factor which led to the implementation of the incentive payment program. It was decided that a standard be set which initially would permit approximately 60% of the producers to qualify for the incentive payment. This would leave sufficient room for improvement. Examination of past records permitted the prediction that a standard of 50,000 per milliliter would suffice. The first month, 62% of the producers qualified! The program has been in effect two years. During the past year this percentage has generally ranged between 85 and 90%, occasionally exceeding the latter. The improvement achieved by the introduction of this plan is self-evident.

The success of incentive payment plans is dependent in large measure upon uniformity of application. Situations whereby quality of milk procured becomes secondary in importance to volume obtained can be demoralizing to incentive payment plans. If the desire of a processor, cooperative or independent, to increase the volume of milk available for processing is so great that quality factors are largely ignored in the price structure, there is little incentive other than personal pride for a producer to put forth the effort to produce milk of high sanitary quality. Consequently, if the marketing structure permits, certain producers will shift from one plant to another depending upon which is more lenient in grading his product. The number of such producers that may be lost to a plant for this reason may be sufficiently large to seriously affect the volume of milk processed and thereby the economy of operation. Under such conditions, quality improvement programs and incentive payment systems, if they existed at all, soon disappear or degenerate to one supported only by lip service.

In conclusion, it should be emphasized that the availability of ample supplies of wholesome milk is essential to the best interests of the consumer and the dairy industry as well. The dietary importance of milk is such that consumption should be encouraged. Necessary precautions must be taken, however, to prevent milk from becoming a vehicle in the transmission of disease. Bacteriological quality, which is so closely related to the over-all quality of milk, must be maintained at a high level for reasons of public health protection and to prevent flavor, chemical or physical deterioration through microbial activity. This can best be achieved by surrounding the production, processing and distribution of milk with influences which encourage the application of sanitary practices.

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