

PAYMENT ACCORDING TO QUALITY

J. EKMAN *

Milk quality is a term of very wide scope. It takes into consideration the proportions of the main components of the milk, the chemical composition, taste and flavour, the possible presence of extraneous substances, the content and action of pathogenic and non-pathogenic micro-organisms, environmental sanitary conditions at the place of production, and hygienic handling and processing between production and consumption.

The object of payment for milk according to quality is twofold: to pay producers an equitable sum for the milk they deliver; and to give them guidance on the kind of milk regarded as desirable. In a producers' co-operative the net income is divided among deliverer-members as payment for the milk in the proportion in which each member has contributed to earning the income. This can be calculated on a purely quantitative basis only under primitive conditions; generally the quality of the milk produced must also be taken into account. Good-quality milk has a better market value and entails less costs than poor-quality milk. This requirement of an equitable price for the milk produced should apply also to other dairies than producers' co-operatives.

The second object of quality payment is based on the fact that the system of payment will always influence the methods and trends of production: quality payment is necessary to stimulate an improvement in, or the maintenance of, hygienic and compositional quality.

Quality payment has thus both economic and psychological effects—it should reflect the market value of milk or milk products of differing quality, and it should influence the producer to adapt the methods and aims of his production (in accordance with the varying costs) to the type and hygienic standard which will give him the best net income. However, under certain marketing conditions there is a limit to the extra amount that can be paid for milk of higher than average quality—a limit set, for example, by abundance of supply, or the social or economic state of the market. A vicious circle results: if there is no market demand for high-quality milk, no high-quality milk is produced and so there is no possibility of increasing

* Technical Department, Swedish Dairies Association, Stockholm, Sweden.

the demand. From points of view other than the short-term economic one—e.g., human nutrition, health and welfare—it may, however, be urgent to improve the hygienic quality or the composition of the milk. In these circumstances a payment system must be based more upon the achievement of a milk quality suited to the social needs of the population; if only the economic aspect is to be considered, the payment system must take into consideration the production costs mentioned above.

In many situations the most economic production policy may be difficult to determine; data may be lacking for the calculation of differences in production costs, or producers may be unable to perform such calculations. The psychological aspect of quality payment consists in the assumptions of the producer about the most profitable line to follow—not in what actually is profitable. For example, the fact that payment has been fixed according to fat content may have led to a rise in fat percentage even though calculation might have shown that the additional payment was too small to cover production costs for the increased fat content. With improved production techniques and increased possibilities for economic evaluation and advisory services, this stage should be passed and future analysis should centre solely on the economic interactions.

Stimulating interest and responsibility in quality payment

In most countries food is subjected to control by the health authorities so as to prevent transmission of disease. It may also be within their scope to prevent adulteration of milk and to guarantee to the consumer a minimum content of important constituents. Minimum standards for quality payment are therefore often laid down in legislation, and in countries where milk production is developing this is a very useful way of stimulating the production of high-quality milk.

Above this minimum level it is mainly a question of the producers and dairies reaching and maintaining a quality of product high enough to compete successfully with other products on the market. If the producers' milk and dairy products do compete successfully, quality payment may be expected to benefit. The responsibility of the dairy side expands with increasing standards of production techniques and market conditions.

So far this chapter has dealt mainly with payment for the producers' milk; it is, however, equally important to have a quality payment system for dairy products, including a testing and grading system for liquid milk, butter and cheese, and some regulation or agreement between the dairies about quality payment. One system is that by which fees are paid by the dairies into a common fund on a quantitative basis, and repaid to each dairy according to the quality of its products.

The fundamental principle of quality payment is that better milk should earn a higher price than milk of lesser quality. Obviously, it is the difference in price that is important, but nevertheless much attention has been given

to the question of whether this difference should be considered as a premium given to high-quality milk or as a deduction from the price of low-quality milk. The important thing is to get a response when quality payment is started. The following outline may be given. When quality payment is started in a region, a premium is added to the price of milk fulfilling certain quality requirements; too many grades should not be used in the first step. Simultaneously, an advisory service and propaganda for technical improvement should be started. When the concept and the economic importance of quality have been established among producers, the system may be extended by introducing deductions from the price of the lowest-quality milk. If the development is successful and the majority of milk produced tends to be of premium grade, it is time to raise the basic or standard price for that milk in a degree corresponding to the premium, and to continue deductions only for the lower grades. As conditions improve, the good milk must be regarded as the norm, and it becomes more urgent to eliminate the remaining milk of really poor quality.

When grading of milk is based on several testings per period of payment, it is useful to introduce a system of progressive deductions for repeated failures; thus milk deliveries of consistently low quality are penalized to a greater extent than those showing a single, possibly accidental, failure. An example of such a deduction system for quality payment of a rather exacting standard is as follows:

	<i>Deductions in monetary units</i>		
	<i>1st testing</i>	<i>2nd testing</i>	<i>3rd testing</i>
Grade I (norm)	—	—	—
Grade II	1	2	3
Grade III	4	6	8

The deductions are totalled at the end of the period, the total covering the whole quantity delivered during the period. The lowest grade milk assigned to Grade III at all three testings will bear a penalty of $4 + 6 + 8 = 18$ units deducted from the normal price.

If quality payment is to have the desired effect on production, the price difference between grades, additions or deductions must bear a reasonable relationship to the standard price. Guiding calculations as to the differences in production costs for milk of different composition are possible, but become much more difficult when applied to hygienic conditions. Some equipment is of course necessary and will entail costs, but much of the hygienic result is due to the skill and interest of the producer—a factor more difficult to express in figures. In respect of hygiene it is likewise almost impossible to provide the dairy with relevant calculations of the economic value of milk of different hygienic standard, because of the difficulty of defining this in a comparable way. Further, the relationship between the quality of the raw material and that of the product depends on the technique

of processing used. There is, however, no doubt about the economic and social importance of high quality, even if we fail to express it in monetary value in individual cases. Price differences must therefore be determined on the basis of what is held reasonable. In the example mentioned above—a rigorous system—the standard price is of the order of 40 units per kg, and the maximum deduction is nearly half of the price, the stage after this being rejection of the milk. It can be said, as a general guide, that a deduction (or premium) rate of less than 10 % of the standard price indicates a lenient quality payment system, and one of more than 10 % indicates a more stringent one. It must also be stressed that increasing economic interference through quality payment must be preceded by the choice of approved tests for quality control (see chapters by Johns and Barber, pages 223 and 303) and by the organization of reliable testing conditions.

Notwithstanding the technical difficulties involved, quality payment for milk is an essential means of increasing the interest and improving the skill of the persons handling the milk from the place of production to the processing or manufacturing plant. This is of particular importance in less advanced countries, where trained personnel and a public appreciation of hygiene are commonly lacking. In such countries it may be of great psychological importance to fix the basis for payment according to progressively improving quality, so that relatively good-quality milk receives a bonus, rather than that milk should be penalized for being below the minimum standard fixed from time to time. While payment according to quality can obviously be put to considerable advantage in countries where the dairy industry has long been developed, the institution of such a system in the less developed countries might have the effect of increasing the price of the milk to the consumer. This point should be very carefully considered when instituting payment for milk on the basis of hygienic quality in such countries.

The technical basis for hygienic quality payment can be either the quality of the milk as tested at delivery, or the grading of the conditions under which it is produced, or a combination of both.¹ There has been much discussion of the problem of whether routine quality tests can assess the quality of the milk in an acceptable way, or whether inspection and grading of the conditions on the farm give a better idea of the real state of the milk. Logically, there is no better way of investigating the quality of a milk delivery than to test the milk itself. If it is felt that the tests do not tell the whole truth about the milk, the testing methods should be improved. A complete test, however, can hardly be performed every day—it has to be based on a number of random samples per period. Since, as is well known, the quality of deliveries can change from day to day, the question arises whether inspection of farm conditions can guarantee decreased variation in milk

¹ See Appendix, page 247.

quality. Several investigations have proved—as most dairymen have noticed—that good milk can be produced under quite difficult conditions, while on the other hand a shining surface is not a guarantee of good milk hygiene. The skill and interest of the milk handlers is in fact of much greater importance than the environment. Few aspects of farm equipment have been shown to be invariable causative factors in the hygienic state of the milk produced. On the other hand, it is, of course, easier consistently to produce milk on a well-run farm than on a poorly-run one.

The practical conclusion of this reasoning is that hygienic quality payment as far as possible should be based upon the actual testing and state of the milk, and that good farm conditions should be achieved through advisory work. Certain fundamental prescriptions as regards the cowshed or the milking parlour may be laid down, but care must be taken to avoid making them too detailed, since experience has shown that detailed regulations may tend to diminish the flexibility, and therefore the economic and technical development, of milk production. Generally speaking, in quality work it must be remembered that agriculture, including milk production, is an economic enterprise comparable with other industries, and that the economic importance of quality is the main argument for quality efforts.

Absence of pathogens as a basis for quality payment

It has been stated above that the milk or the milk product itself should be the primary basis for judging milk quality. It may seem, therefore, somewhat contradictory to specify freedom from pathogens as a basis for quality payment, as this property of milk must to some extent be judged by tests on the cow. Some infections may affect cattle as well as people, e.g., tuberculosis and brucellosis, and the eradication of such diseases from cattle is an important factor in the control of the human forms. For tuberculosis, the state of the milk is guaranteed by tuberculin testing of the herds. It should be noted that there is a definite and proven connexion between the health of the cow and the state of the milk; *Brucella abortus* can be detected in the milk itself. Diseases other than these may come into the picture in the future. Direct help in eradication of disease has been necessary, but, to attain results and to consolidate gains, the payment of a bonus for herds that have been rendered free of these infections has been an important aid in many countries. This bonus may be paid either by the State or by the dairy organizations, both of which have an interest in the problem; once the diseases have disappeared there is no special need for a bonus. In countries where the eradication of certain infectious diseases which are also pathogenic to humans is planned, a bonus payment system can be recommended on condition that the absence of pathogens in the herds or in the milk can be clearly shown. The risk of reinfection of the milk during handling should be noted. Here the mastitis problem should be mentioned; it may be

infectious or non-infectious, and in most cases the infectious types are not pathogenic for humans. Mastitis is largely influenced by environmental factors and cannot be eradicated in the way that tuberculosis can. The results of efforts to control it may be very different in different herds. At the moment there is no simple and adequate way to deal with the mastitis problem in quality payment. Perhaps future developments may make this possible—for example when the connexion between udder health, leukocyte count, and CMT (California Mastitis Test) reaction has been well established.

Payment according to the keeping quality, etc., of the milk

Keeping quality is often used as a summary term to include the bacteriological state of the milk as well as such chemical changes as are dependent on the length of time for which the milk is kept, e.g., oxidation. However, in most cases payment is based on certain tests used, and those assessing the bacteriological state of the milk are not those used to check the chemical changes. The term keeping quality can be used in the narrower chemical sense covered by the dye reduction tests, etc., and is so used here. These tests chiefly measure in different ways two factors in the milk—the degree of acidity and the reduction-oxidation conditions. Both are largely related to the bacteriological state of the milk, but are not ideal for differentiating between the effect of the number of bacteria and of their activity. The tests can show that a milk is poor, but cannot show clearly whether this is due to severe contamination at milking or to faulty handling after milking. On the average there is good correlation between the result of the tests and the actual condition of the milk, but in individual cases the tests may fail—for example, extreme cooling may help a rather low-grade milk to pass the reduction tests.

In some countries, the standards for grading are changed seasonally or day by day, according to the outside temperature. Thus the milk is required to fulfil less exacting standards on a warm day than on a cold day. An alternative system is, when the weather is warm, to require special care to be taken of the milk, if possible, so as to assure a high quality, as the standards for grading remain unchanged. There are arguments for both systems. On the one hand, it may be unwise to discourage producers by making it impossible for them to produce a high-grade milk on a warm day. On the other hand, the consumers' demand for keeping quality is no less on that day—rather the contrary. This problem should be looked upon as a question of development: when the concept of quality and the techniques of hygienic production become familiar to producers, there is little reason to accept a lower-quality milk in summertime than in wintertime. The peak of the production curve comes in the summer, at least in the temperate zones, and it is important for the dairy industry to preserve the quality of this additional production at a level that will ensure its sale.

Chemical changes that occur are noticed together with other defects in taste and flavour due to fodder, contamination, exposure to sunlight, etc. The test is a subjective one, but important for the quality of the products. The ability of the testers to notice the defects may differ, and it seems reasonable that objections should be made only when the defects are conspicuous. To give the producers confidence in the quality payment system, it is advisable not to penalize failures for which no remedy can be suggested. For this type of failure, the first step is to ascertain the causes by further research.

The cleanliness of milk is tested by the filtration or the sedimentation tests. In some countries filtration on the farm is forbidden, elsewhere it is not. The reliability of the tests largely depends on the earlier treatment of the milk tested. For quality payment, the test results are more reliable if the milk has not been filtered before delivery. The filtration test can then give a fairly good indication of the standard of hygiene on the farm.

Payment according to composition

Milk consists of water and solids dissolved or dispersed in it. It is the solids that constitute the economic value of the milk—a fact so simple that it has sometimes been forgotten in discussions on the composition desirable. The main solid components are milk sugar (lactose), salts (ash), fat and protein. For physiological reasons the percentage of ash and lactose is fairly constant. A variation in total solids depends mainly upon variations in the fat and protein content. A variation in the amount of lactose formed in the udder per day results in a corresponding variation in the volume of milk produced, as the percentage of lactose is kept “constant”. If the amount of fat and protein does not then change, the percentage of these components will obviously vary, but in step with each other. Partly because of this mechanism, and partly because of factors influencing the formation of fat as well as of protein, there is a rough correlation between the percentage of fat and the percentage of protein in the milk. This correlation may be fairly good in bulk milk from a dairy, but is much less marked in the bulk milk from different herds, and hardly exists in the milk of individual cows. The practical consequence is that at the dairy the fat content of a known type of milk—that used for cheese-making, for example—is sometimes regarded as an acceptable measurement for labelling the composition of the milk. However, it must be recognized that payment according to protein content as calculated from the fat percentage is dubious except as a theoretical average, and is not applicable to the actual individual case. If the price of milk is to be fixed according to protein or total solids or solids-not-fat, analyses other than fat testing must be performed. Recently, several methods for large-scale determination of protein and total solids have become available to dairies; it may be said that whichever component may

be chosen as a basis for quality payment, the technical difficulties concerned have been solved, and the problem remains an economic one with a biological background.

Milk of average composition gives a calculable amount of milk products at the dairy. What is the economic importance of a variation in one or several components? Briefly, it is as follows. Liquid milk in many countries is priced only according to volume, and a variation in the components has no direct economic importance. It makes no difference whether or not there is a legal minimum level in the composition so long as the milk is only slightly above that level. When the milk is standardized to a constant fat percentage, e.g. 3%, fat above that level can be used for cream or butter-making and has a calculable value. Occasionally a premium is given for fat content above a certain level, which implies a direct evaluation of the surplus fat. In cheese-making a variation in both the fat content and the protein content influences the yield of cheese, and the variation is thus of economic importance. In butter-making the yield of butter is fairly proportional to the fat percentage, and the fat value can be calculated from the butter value, whereas a variation in protein content is of no importance. From these examples it is obvious that the use of the milk for different purposes decides whether there is any reason to take one or other of the milk constituents into account in quality payment. In addition, social or political considerations may be involved. The difference between percentage and amount must be borne in mind: there is, in a very general way, an inverse relationship between the concentration of the solid components and the volume of the milk. A possible surplus production of milk fat is scarcely overcome by striving towards a lower fat percentage in the milk, since instead the volume of the milk will probably increase and counteract the supposed decrease in the amount of fat. Because of the rough correlation between fat and protein content in the milk, it is also unwise to assign payment to protein content instead of fat content in a fat-surplus situation, as was often suggested in western Europe in 1958. It is of fundamental importance that any compositional payment system be thoroughly considered from the standpoints of how the milk is to be used (liquid consumption, specific type of manufacture, etc.), of market conditions, of social aspects, of lactational physiology, and of production economy. Unless this is done, quite unexpected effects may result.

Appendix

PAYMENT ACCORDING TO HYGIENIC QUALITY *

“ ... Any method of payment on quality obviously entails the application of a standard method of quality assessment to all consignments or to significant samples of the consignments of each producer's milk. The assessment must be made by an objective test at the first point of milk delivery, i.e., before the milk is bulked. In countries where milk passes through collecting centres before going on to a dairy plant for processing, samples for testing should be taken at the collecting centre. Farm inspection will assist in arriving at a conclusion as to the worth of the farmer's methods, but it is on the quality of the product on reaching the point of first delivery that payment should be made.

“ The hygienic quality of the milk may be judged by one or more of a number of well-known tests, the choice among which may not necessarily be the same for different countries or districts. But whatever the test used—reductase, acidity, sediment, etc.—as a basis for quality payment, *testing must be done by a competent tester* who has the confidence of the milk producer. The actual test or tests used must depend in part on the purpose for which the milk is to be used and in part on local conditions. Where testing has to be done in small collecting centres, the number of competent testers required in a given milk-producing district may be large, and may thus involve serious training problems. How frequently this objective examination of each producer's milk should be made depends on local testing facilities and other local conditions; preferably, it should be done at least twice a month.

“ Several systems are in use as a basis for quality payments. Any system to be used for such incentive payments must be adapted to local conditions. One is to ‘classify’ or ‘categorize’ a producer on the average results of a dozen tests over a period of six months (as, for example, on the number of unsatisfactory reactions to dye reduction tests applied during this period), and to pay him for the succeeding six months on that basis, revising his category if need be at the end of the period and so on. Three categories would seem to be the most appropriate number, the first of these to receive a bonus, the second, the standard price, and the third, a penalty.

“ The final penalty for very poor quality is to return the milk to the producer without payment. This drastic action, or even a reduction in payment, is usually followed by anxious demands for advice and help in improving matters. An almost inevitable corollary, therefore, of any payment-on-quality scheme must be a competent advisory service, run

* Reprinted from: Joint FAO/WHO Expert Committee on Milk Hygiene (1957) *First report*, Geneva (Wild Hlth Org. techn. Rep. Ser., 124; FAO Agricultural Studies, No. 40, Rome).

either by the dairy organization—which may be a farmers' co-operative—or by the national agriculture, public health, or veterinary advisory corps, which body must keep in closest touch with the dairy and be thoroughly conversant with milk production difficulties.

“Such an advisory service costs money, and must either add directly to the consumer price of milk or be financed out of public funds. In most countries where quality payment has been adopted, this extra expense has been considered well worth while, in view of the higher quality and greater value to the dairy of the milk produced.

“In several countries, a bonus payment has been made in recent years to producers whose herds pass the tuberculin test. Such a bonus may be paid on the number of animals in a tuberculosis-free herd, or, better, on the amount of milk sent to the dairy. Here again, six-monthly categorization is the usual practice, a producer being paid his bonus after a completely satisfactory test, pending the results of the succeeding routine test becoming available.

“The amount of the hygienic quality bonus or penalty must have some reasonable relationship to the standard price. For milk from tuberculin-tested herds, the bonus may be of the order of 10 % or even more of the standard price; for milk of first-class quality, as judged, for example, by a properly-controlled reductase test, a bonus of similar amount would almost certainly lead to a rapid improvement in the average quality of the milk reaching the collecting centres. A penalty of the same order on milk of unsatisfactory quality would almost certainly have a similar effect in raising average quality and would not involve any expense on the part of the dairy plant. It is on the whole better to impose a severe penalty for really poor milk and to use such milk for some purpose other than the fluid milk supply, rather than to send it back to the farmer. The return of a can still containing poor quality milk to a small farmer with inadequate can-washing and bactericidal treatment facilities may mean contamination of the next day's consignment. It has been found advantageous to give a farmer who has been penalized the opportunity of seeing for himself in the collecting centre the results of the sediment test or the reductase test on his milk.

“Whether the dairy plant should apply the same standard for the judgement of milk all the year round or whether the standard applied should be higher in the cooler months of the year is a debatable point; the weight of opinion would seem to favour a single high standard which will naturally be more difficult to attain in the warmer seasons.

“Payment on hygienic quality of milk (as determined, for example, by the reductase test) may be combined with payment on the tuberculin-tested-herd status, and also with payment on compositional quality (as determined, for example, by percentage of fat or total solids in the milk).”