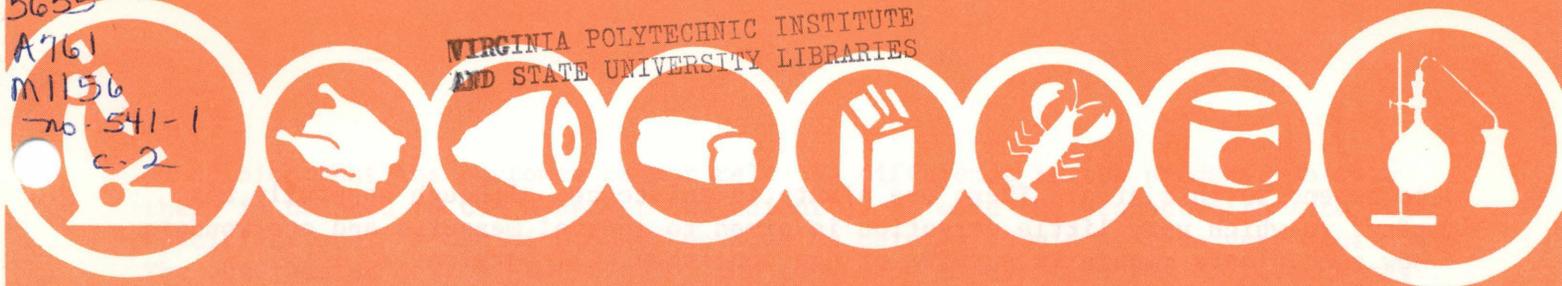


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Food Science and Technology Notes

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IDENTIFICATION OF TECHNICAL PROBLEMS IN THE MANUFACTURE OF ICE CREAM

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We are living in an era of unparalleled technological advances, when getting to the moon is a reality and when the word "impossible" must be uttered with extreme caution, lest one is quickly proven wrong. In such a climate it seems highly unlikely, as well as anticlimactic to profess that technological problems are being encountered in such a mundane activity as the manufacture of ice cream. Even if we admit that it is only natural for technical problems to arise, it is hard to see why they persist almost undiminished in this era of technological revolution. In most instances we possess the necessary knowledge to make the best possible product and should we require help, we need only to call on one or more of the many available people of experience and wisdom who know the answers or who can find the answers to most technical difficulties. Yet, the problems persist. One only needs to pick up samples at the retail market or even examine products which have been submitted by the manufacturers themselves for evaluation at ice cream clinics to see the extent of the failure to make complete use of the store of knowledge which is available.

Let us, therefore, accept the proposition that everyone knows how and where to find specific solutions to specific problems. These may include the selection of ingredients, the formulation of the product, equipment problems, the type of processing to be employed and factors relating to all other phases of the manufacturing and distribution process. An analysis of the remaining manufacturing control parameters should help us isolate and identify some of the troublesome areas which are the cause of the high incidence of technical problems.

Regardless of the volume produced, there are certain control measures which should be in operation in every plant. Theoretically, in a one-man operation, one would expect nearly perfect control, assuming that the individual is aware of its importance. As more people become involved in the manufacture of a product, the control procedures need to become more formal and responsibilities must be fixed for the execution of each phase. Quite often it becomes a matter of degree, the vigor of execution being largely dependent on the energy which management wishes

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to expend in this area. There are plants in existence, although hopefully not many, in which very little attention is given to control measures and one wonders how such plants manage to survive or how long they will survive.

There is no requirement for a fixed form of a document stating the company's policies relating to technical control, but regardless of how they are stated, they should identify effective measures to help achieve the following objectives:

1. Control over the quality of raw materials. This includes dairy ingredients and non-dairy ingredients, such as flavoring sweetening agents, stabilizers and emulsifiers, and should be concerned with the composition, bacteriological quality, flavor, texture, color, absence of extraneous matter, and uniformity. Particular attention should be given to the bacteriological quality of those items which are added to ice cream after the mix has been pasteurized.
2. Control over composition and formulation of all manufactured products. Attention must be given to the basic mix, the amount of flavoring and color used and the weight of the finished product. This will help to ensure compliance with legal requirements and provide for product uniformity. The ingredient cost of the finished product cannot be known with certainty unless this phase of the control program is carried out. Each product should have its rigid specifications which must be adhered to. Company approved formulations stated in fine detail should be a matter of record so that any product can be made any time, regardless of who is on vacation, ill at home or just quit the job.
3. Temperature control. Ice cream is particularly susceptible to developing undesirable attributes as a result of improper or fluctuating temperatures. It is known that pasteurization temperatures affect the body and texture of ice cream and may also affect the flavor. The homogenization temperature should be controlled to avoid undesirable viscosity. The temperature to which mix is cooled, the freezing temperature, the hardening rate and final temperature, and temperatures during the various stages of distribution are all extremely important because of their effect on the characteristics of the finished product.
4. Sanitation control. This program must be clearly outlined in every detail and management must insist that all of its provisions are carried out. This involves not only cleaning and sanitizing of equipment, but also the filtration of air, repair of floors, walls and ceilings, provisions for the control of insects and rodents, elimination of condensate drippage, personal hygiene of employees, and other related factors. Specification for the bacterial counts of the finished products should preferably be more rigorous than the maximum numbers permitted by legal standards.

It would be desirable if, to the extent necessary, the essential features of these four technical control measures were known and understood by all employees whose activity is influenced by them in any way. The responsibility to carry them out may rest with different individuals, but the functions should be coordinated with each other, with other technical measures, such as maintenance, and with other company management controls.

Let us now examine some of the factors relating to management practices which will affect the character of the product which the company produces. There may be

an opinion that the customer cannot tell the difference in the product, so that there is no need to use a better ingredient or to make the product with more rigid specifications. A decision based on such an opinion should be made very cautiously. The observation that a good many of the consumers cannot tell the difference may be quite correct but it is also possible that while some of them cannot tell the difference enough to complain or even comment about it, their unwitting reaction may be a lower level of consumption. The cost squeeze may force a manufacturer to make a cheaper product than he would like to, but even a cheap product does not necessarily have to be a poor product. The best way to look at it is that it should be the best possible product which can be made in the required price range. If there is still a profit in it, the better quality product should have an advantage in the market place. If there is no profit in it, it is questionable whether the product should even be manufactured.

There are several important factors which relate to production management that can exert a considerable influence on the quality of the finished product. Production planning is a difficult task when it must be coordinated with equipment capacity, the normal rate at which the products are sold, unusual demands due to special promotions and the available space in the hardening room. This is frequently complicated by limited space availability in company branches and other warehouses where the product is stored and fluctuating demands for some products.

A common observation is that there are too many items in the inventory and many of them move entirely too slow. One or more salesmen may insist that they must have certain items in order to keep a large account and soon there are several slow moving items occupying valuable space in the hardening room. These items may become quite old before they reach the market place and their deteriorated quality may reflect on the remainder of the company's products. This becomes a particularly difficult problem for the production planner who doesn't want to overstock, but is forced by the size of his equipment to make some minimum size batch. It is necessary for the sales department and the production department to have a perfect understanding of each other's problems and whenever possible, slow-moving items should be eliminated from the inventory as they are too costly.

Inventory control falls into a related category and may also lead to similar problems. The necessity for an accurate daily accounting of the items in the inventory is obvious. The production manager should have a running record of every individual item, day by day, as it enters and leaves the hardening room. The management of the hardening room may need to come under scrutiny. It is imperative that stocks be rotated and that certain items not be literally buried. It must also be remembered that there is a difference between hardening and storing of ice cream and lack of space frequently prevents proper stacking of the product.

"Negative quality control" is a term which I use to describe a program which is only marginal or, for all practical purposes, nonexistent. In some plants an effort is made to run a few tests just to insure compliance with legal requirements of bacteria count and product composition but there are instances where even these tests are not performed routinely and the only visible quality control is a burst of reaction coming on the heels of a customer complaint or an uncomplimentary report from a health regulatory agency. This results in an operation which is a series of crises and which may lead to many inconsistencies. A quality control program should be positive - it should anticipate as well as react. It is a diagnosis as well as a treatment. I am amazed at how some manufacturers are able to get by with practically no laboratory control or any other quality control measures.

The absence of a vigorous quality control program would be expected to be the result of a failure to establish a product image. Some nationally marketed products, as well as many locally produced ones, give an immediate impression of uniqueness and rigidly enforced specifications. Uniformity, then, becomes the key to continued high level of acceptance. The product image is directly related to the four technical control measures cited earlier.

Product specifications should include a statement on what is expected from all ingredients functionally as well as quality-wise. Substitutions should not be made indiscriminately or capriciously. However, when adequate trials indicate that the substitution would be advantageous, there is no reason to discourage the change.

Occasions arise when the processing conditions need to be changed. In recent years many manufacturers have converted from batch pasteurization to high-temperature short-time pasteurization. This is a major change-over which is usually motivated by a desire to effect savings in processing cost as well as an increase in the production capacity of the available plant space. However, when such a change is made, it is necessary to understand that the heat treatment of ice cream mix is not only designed to destroy bacteria and enzymes, but that it also contributes to the body and texture of ice cream. Changes in the mix making procedure may be necessary and the optimum time and temperature should be carefully established so as to avoid quality loss.

The problems which may be encountered because of inadequate ice cream freezer capacity or inadequate refrigeration are well-known to every ice cream maker. When the product has to leave the freezer two or three degrees higher in temperature than specified in the company's temperature control policies, it is bound to have a poorer body and texture than would be desired. Yet, it may be necessary to operate the freezer at this higher temperature in order to realize the capacity established as the normal day's production. The burden is certainly on management to determine whether an additional compressor, a larger freezer or an additional freezer should be purchased or whether the quality difference is to be ignored.

Hardening rooms very frequently become too small in a growing operation. When this happens there is really no easy solution possible with available facilities. To get the ice cream properly hardened, it must be stacked so as to leave sufficient space for air circulation. The following day, usually, the ice cream must be re-stacked, this time much tighter and higher so as to utilize as much of the space in the hardening room as possible. Such multiple handling of the product complicates inventory control and is costly on labor. A situation may be eventually reached when the space in the hardening room is insufficient even under double handling procedures and the ice cream simply is not properly hardened to impart to it the desired body and texture characteristics. Under such conditions, one may observe discoloration of the surface of the ice cream, as under its weight and in its soft condition, it loses some of its overrun near the surface. The icy texture is quite noticeable and one may try to overcome this condition by over-stabilization and incorporation of a higher content of solids. This may partially solve the problem, but may create new problems of its own. The decision must now be made whether to enlarge the present facilities or to use the present facilities for storage only and install one or more types of the continuous hardening systems. This decision should follow a careful analysis of the direction in which the business is heading with respect to types of products, container sizes and shapes, volume of each container size and projections as to future growth.

Temperature control over the product on delivery vehicles is universally accepted as highly desirable but is frequently practiced only in spirit. Several trips on an ice cream truck may be quite damaging to ice cream. A question sometimes arises whether the ice cream truck keeps the ice cream cold or whether the ice cream is keeping the truck cold. This is a particularly difficult problem during periods of high humidity.

In spite of the considerable heat shock that ice cream may experience during its transportation to the market place, this may be minor by comparison to what may happen to it from this point on. Every effort should be made to enlist the cooperation of the market operators in preventing additional heat shock to the product. Even then, it can be expected that the ice cream will suffer further temperature fluctuations on its way from the grocery store to the housewife's refrigerator or deep freeze and eventually to the table. Obviously, it would be desirable that the ice cream receive as little heat shock as possible before it starts on its last trip to the ultimate consumer.

Ice cream is made by people, even in an automated plant. People have their attributes and their shortcomings, and people are known to make mistakes. Very often the quality of ice cream is the result of a mistake or a failure to correct a mistake or a cover-up of a mistake. When one opens the wrong valve and corn syrup is unloaded into a sugar syrup tank, a human error has occurred. One can correct for this in the formulation or one can try to cover-up or one can make an error in the correction. Mistakes happen frequently. A certain quantity of flavoring is to be distributed in ice cream through a fruit feeder. By mistake, the setting may be too small or too large and the flavor concentration is inaccurate. The mistake may be covered up by compensation. Thus, a part of the ice cream will have insufficient flavor and another part too much flavor. In another instance, a batch of ice cream may be misformulated and without quality control checks, the mistake is not immediately observed. When some quality control measures are taken, such as a fat test, the correction of the fat content may be made with no regard to the remainder of the batch. There are many examples of such mistakes. It appears, in fact, that most problems experienced in a plant, in which otherwise good control measures are exercised, are the results of mistakes on the part of the employees rather than a lack of technological know-how.

A quality control program should strive to anticipate where mistakes could be made and procedures should be set up which everyone understands and is able to follow. Unfortunately, however, even under such conditions some mistakes will be made. The best that one can hope for is that these mistakes are immediately reported and that individuals in the organization who are responsible for production, know how to make the necessary corrections.

In summary, there are four technical control measures which are the minimum requirements for adequate assurance that acceptable procedures are followed. Failure to exercise these control measures leads to deficiencies in product quality and may result in increased cost due to waste as well as reduced sales. In spite of all our technical knowledge, problems in ice cream manufacture will probably always exist, and I have pointed out how some of them may be due to the attitude of management as well as employees, to inadequate facilities for production and to mistakes which people are prone to make and which they sometimes like to cover-up. There may be even an isolated case where a person has

his own idea of what constitutes quality and even though not many people agree with him, he refuses to change his opinion. If we have an idea of what constitutes quality in ice cream, we should convince ourselves that our idea is shared by those who buy the product.