must be taken in the interpretation of coliform results on fruit ice cream especially when the solid media presumptive tests are the only coliform tests made on the ice cream. We recommend that Standard Methods for the Examination of Dairy Products be followed carefully in the examination of frozen desserts as it is essential that confirmed tests be made to avoid the reporting of false positive coliform results.

In conclusion, we realize that these studies are by no means complete and our own investigations are continuing. There are many aspects of the problem yet to be investigated such as a quick short method for the differentiation between true and false coliforms, identification of the false positive types, studies on their heat resistance, the effect of freezing and thawing, survival in frozen puree and in ice cream, and the normal flora of other fruits. Eventually the answer will be forthcoming, but the future certainly requires further research on this problem of false positive coliform tests in fruit ice cream.

MOLD CONTROL IN BAKERIES

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The spoilage of bread and other foods by mold growth is a constant problem causing food losses both in homes and in industry. Spoilage due to molds occurs because large numbers of mold spores are widely distributed.

Molds growing on bakery products generally are not pathogenic nor are they poisonous to man; however, the bakery customer will be quick to reject any baked product which has visible mold upon it or which may become moldy too soon after purchase.

Some molds are valuable and necessary for processing such important commodities as cheese, malt supplements for brewing and bread making, and for the production of famous anti-biotic “miracle” drugs.

Molds belong to the Sub-phyllum of the Plant Kingdom called Fungi. The Fungi may be further subdivided into six Classes. Most of the molds of economic importance are members of three of the six Classes.

These three Classes are:

1. Ascomycetes. This Class includes yeasts, ergot producing parasites, and those molds which forms spores within a membrane sac called an ascus.

2. Fungi Imperfecti. This Class includes such common genera of molds as Aspergillus, Penicillium, Monilia, and others.

3. Phycomycetes. This Class includes common genera of molds such as Rhizopus and Mucor which cause spoilage of fruits, bread and other foods.

Mold species commonly encountered in bakeries belong to the genera Rhizopus, Mucor, Aspergillus, Penicillium, Fusarium, and Penicillium. The spores of these molds are commonly present in the air, especially if the air is dusty, since most molds readily grow in soil. Damp or wet areas surrounding a bakery or within a bakery usually have mold growth associated with them, and the spores of these molds are directly inoculated into the air especially during the summer months when temperatures are more favorable for mold growth.

The names and classification of molds are not nearly as important to the baker as methods of mold control. Regardless of the kind of mold found, the problems and methods of control are the same as for all living organisms. The conditions of moisture, temperature, pH, and food supply are the important and basic principles on which mold growth or control of their growth are based.

Molds do not grow without a source of moisture. If the moisture content of a food or a surface on which molds might grow is reduced to less than 15 per cent, the molds do not thrive; thus, dehydration may be used to preserve foods and, also, to prevent the growth of molds in such areas as bakery proof boxes or fermentation rooms. However, it is not practicable to dry bread or cake to control molds because drying will reduce the palatability of the products to such a degree that they could not be sold.

On the other hand, frequent drying out of the proof box or fermentation room will help control mold growth on the wall surfaces.

In the control of mold growth in bakeries, it is important to eliminate moisture on the cold water and refrigeration lines, especially those on the cooling units of the wrapping machines. (Mold growth is commonly found on such surfaces.) This should be done by use of proper insulation material. The careful handling and maintenance of pan washing equipment and of garbage containers, and proper maintenance of plumbing, including floor drains to keep water in its proper place, are important in the control of molds.

Because proper temperature conditions are necessary for mold growth, this principle also may be used for its control; for example, freezing or sterilization by heat. During baking of bakery products, temperatures are reached which effectively kill all mold mycelia and mold spores which may have contacted the dough.

Molds grow best at temperatures of 50° to 100° F., but they may grow at temperatures as low as 60° or as high as 120° F. In some bakeries, it is possible to raise the temperature of the proofing room.

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Mold Control in Bakeries

or fermentation room sufficiently with hot dry air to kill all active molds. This requires a temperature near 160°F. for 10 minutes.

Another aspect of mold control in a bakery is that of controlling mold contamination of bakery products after the products leave the oven and before they are wrapped. If bread or other bakery products could be taken from the oven and immediately wrapped and sealed in clean sterilized containers, molds would not develop because inoculation with mold spores would not likely occur. Unfortunately, this is not possible because bakery products must be cooled before proper slicing and wrapping can be completed.

The degree of acidity or alkalinity (pH) is important to mold growth because molds grow best at a pH range of 4.5 to 6, however, they may grow within the range of pH 3 to 9. Bread having a normal pH of 5.2 is well within a favorable pH range for mold growth. The pickling of foods such as cucumbers and meat is an example of a process which results in reducing the pH of a food product to a range within which molds do not grow readily. In some areas of the bakery, such as floor drains, garbage disposal areas, pan washing areas and shower stalls, the principle of "pH control" may be used in treating these areas with dilute caustic or alkaline cleaners. This will raise the pH above that tolerated by the molds. It is not practicable, however, to change the pH of bread to control mold growth. However, the use of vinegar (acetic acid) has been used with some success. Although there is good reason to believe that any inhibition of mold growth which might occur may be due to effects other than that of low pH, if it were possible to remove all sources of food for molds from the bakery, there could be no mold growth. However, this is not practicable, but the principle may be used successfully for good mold control. This principle is effective housekeeping or in other words strict sanitation, whereby materials which molds may use for food are removed from all surfaces often enough to prevent the accumulation of molds. It is extremely important to remove all dough and ingredients from the make-up machinery of the bakery at regular intervals and from every crevice and surface. This will assist in controlling insect infestation as well.

One of the most important factors in controlling the growth of molds in bakery products is the prevention of contamination of such products by mold spores. This is especially necessary in the cooling and wrapping areas after the bakery products are taken from the oven. Prevention of mold inoculation of the products requires strict sanitary conditions at all times. Cooling racks, conveyors and any surfaces which may contact the baked product must be clean. Cooling of bakery products should be done in a dust free, clean room and fans used for cooling these products must be clean. The cooling air should be free from dust and mold spores. Careful placing of the fans to be certain the incoming air is drawn only from the cleanest possible areas will greatly reduce the inoculation of bakery products.

Operators of slicing and wrapping equipment should be the cleanest personnel and should possess the best hygienic habits of all bakery employees. Needless to say, the wrapping and slicing equipment must be kept clean and sanitary. The refrigeration units and lines of the wrapping machine should be well insulated and kept clean and free from mold growth.

Too often proper storage and handling of paper, cellophane, trays and other wrapping supplies is neglected. All of these materials should be treated and kept as sanitary as possible. Wrapping supplies should be well protected from dust at all times and must be kept off the bakery floor even while changing rolls of paper on the wrapping machines.

Sweeping bakery floors is certainly necessary during slicing, cooling, and wrapping of bakery products; however, this should be done with the minimum of dust raising since any drafts carrying dust to the products also will carry mold spores. Vacuum cleaning should replace ordinary sweeping methods in this area.

In addition to the control of molds by low moisture, high or low temperatures, pH, and cleanliness, inhibitors of mold growth such as sodium or calcium propionate or sodium diacetate may be added directly as ingredients. These are not fungicides but serve only to inhibit or retard the growth of molds. Therefore, they cannot be relied upon to keep bakery products mold-free indefinitely.

Certain non-toxic disinfectants may be applied to the walls or floors of the bakery to destroy and inhibit mold growth. Careful selection of such materials is essential and no poisonous materials should be used.

Mold inhibiting paints also are available for walls and ceilings for proof boxes, fermentation rooms or other areas. Although they are not completely fungicidal, certain non-toxic paints containing quinolinolates may be valuable aids in inhibiting mold growth. Ultra-violet lamps have a very limited application to the control of molds in bakeries. The destruction of molds in bakery products by radiation may become highly important in the future, but as yet, this method is not in general use.

Since the baker cannot, for practicable reasons, change the moisture content, the pH or the storage temperature of his product, his problem of mold control is essentially directed at preventing the inoculation of bakery products from the time they leave the oven until they are wrapped in clean sanitary sealed packages. The prevention of mold growth thus requires careful engineering and expert sanitary care not only of areas where mold might grow, but also the entire area where the products are processed after baking. In doing this, he must rely mainly on the principles of moisture control, temperature control, pH control, strict sanitation, and the use of inhibitors of mold growth.