SHELL EGGS:

Preventing Mould Growth

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WHAT ARE MOULDS?

Moulds are microscopic fungi. No one knows how many species of fungi exist, but estimates range from tens of thousands to perhaps 300,000 or more. Most are filamentous (threadlike) organisms and the production of spores is characteristic of fungi in general. These spores can be transported by air, water or insects.

Unlike bacteria that are one-celled, moulds are made of many cells and can sometimes be seen with the naked eye. In many moulds, the body consists of threadlike roots that invade the food, a stalk rising above the food and spores that form at the ends of the stalks.

The spores give mould the colour you see. When airborne, the spores spread the mould from place to place like dandelion seeds blowing across a meadow.

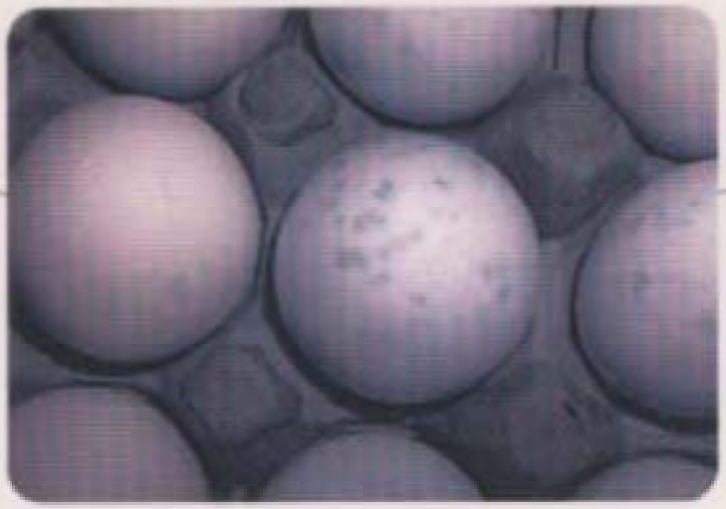
Moulds have branches and roots that are like very thin trees. The roots may be difficult to see when the mould is growing on food and may be very deep in the food. Foods that are mouldy may also have invisible bacteria growing along with the mould.

PROBLEM OF MOULDS ON EGGSHELLS

Several factors influence the potential for mould growth. The most likely factor impacting mould growth on eggs is moisture. The moisture on eggshells may be due to high relative humidity, sweating, moisture remaining after washing, etc. If the eggshell remains moist and mould spores are present, growth will most likely occur.

Initial mould growth is not always visible to the naked eye. Careful observation is usually necessary to detect the white growth, which consists of hyphae about 1 to 2 mm long. Commercially, the term "whiskers" is applied to this growth of mould on eggs. Luxuriant mould growth on the shell surface, with the production of spores (gray or black mould), can lead to mouldy interiors.

In the storage of eggs, it must be assumed that mould spores are always present in the air and on the surface of the eggs. The storage conditions must be so regulated that harmful mould growth on the eggs does not take place.



TYPES OF MOULDS

Fungal contamination can be found in egg grading operations. *Cladosporium* and *Penicillium* species are the most common found on eggs, grading equipment, and growing around air-conditioning ducts and refrigerator seals. *Aspergillus* has been found on eggshells on some farms and in some supermarkets. *Aspergillus* and *Fusarium* are considered a problem because given favourable temperature and humidity, they will produce toxins harmful to people. In general, a wider range of fungi can be found on eggs than on the grading machines. These fungi are common in the air which most likely contributed to the contamination. Comparison of plastic versus cardboard cartons indicated that eggs placed in plastic cartons were less likely to have fungal contamination than those placed in cardboard cartons.

Mould growth is generally more of a problem in eggs stored for long periods of time. Mould toxins on eggs are mainly influenced by the concentration of toxins in feed, temperature, air humidity in storage rooms and the contamination of the shell with fungi. The penetration of toxins through the eggshell into the content is generally very low. However, from a viewpoint of health risk for egg consumers, the inhibition of growth of fungi is of great importance and it is necessary to adopt preventive measures.

CONTROL MEASURES

Throughout the marketing chain (farm to table), care should be taken to avoid contamination by the environment, equipment, packaging materials and general handling. Controlling moisture and temperature and maintaining good sanitation are the keys to the prevention and/or control of mould on eggs.

RELATIVE HUMIDITY

A relative humidity of 75 to 80% in egg storage rooms must be maintained to prevent moisture loss with a subsequent loss of egg mass. Too high a relative humidity causes mould growth, which can penetrate the pores of the eggshell and contaminate the egg contents. Mould will grow on eggs when the relative humidity is above 90%.

The relative humidity in the storage cooler environment is usually lower than that at the shell surface of the eggs in the centre of the cases and deep in the stacks of cases in the room. The variation in relative humidity is dependent on the circulation of air in the room and on fluctuations in temperature. The relation between the growth of mould and the relative humidity in the aisle and at strategic points in the room is impacted by the temperature, temperature fluctuations and the circulation of the air; the moisture conditions of fillers, cases and any other materials in the environment; and the loss in weight of the eggs. Dehumidifiers may be necessary in storage coolers to reduce the relative humidity to an acceptable level.

TEMPERATURE

When evaluating temperature, it is important to differentiate between egg temperature and environmental temperature. Studies have shown that eggs with temperatures ranging from 33°C to 39°C placed individually (not in flats) in a cool room at 10°C with moving air lost almost 11°C per hour. Work conducted by the Canadian Department of Agriculture indicates that the container in which eggs are gathered, cooled or held has a significant effect on the rate of cooling. Eggs with an internal temperature of 27°C to 38°C were either placed on fibre flats and stacked six high or trayed in flats and placed in 15-dozen fibre cases before being placed in a 10°C cooler. Eggs in the outermost cells of the flats were at 10°C within 24 hours. However, eggs at the centre of 15-dozen cases had not reached 10°C after 36 hours. Research conducted by Anderson et al. (1992) found it took 10–14 days for the eggs in the centre of the pallet to reach the ambient air temperature. The key to cooling is the air circulation around the individual egg regardless how it is packaged. The degree of exposure to air circulation is dependent on "openness" of the container. The air circulation around individual eggs could also potentially impact the moisture on the eggshell.

ENVIRONMENT

Moisture often condenses on the shell surface when cold eggs are moved from the cool storage into warmer environments. Sweating can also occur if temperature varies widely in the cooler. Sweating results in a wet egg and may result in paper packaging materials becoming moist. This wet environment increases the potential for mould spore germination. Plastic wrapped around pallets to stabilize the load for shipping can also prevent moisture loss and increase the humidity within the pallet, which can cause mould problems when eggs are held too long in this condition. Mould growth due to sweating would most likely occur on eggs in the outer edges of the pallet. It would take many hours for the temperature changes to reach the eggs in the inner most part of the pallet and cause them to sweat. The table below (Zeidler et al., 2002) can be used to estimate typical conditions in which sweating may occur.

ENVIRONMENTAL TEMPERATURE °C	ENVIRONMENTAL RELATIVE HUMIDITY (%) EGG TEMPERATURE	
	2°C	10°C
12	72	—
15	60	—
18	50	73
21	40	60
24	34	50
27	28	42
30	24	35
33	20	30

SANITATION

Sanitation throughout the egg marketing chain is crucial to reducing potential mould growth and spore germination. Coolers and storage areas need to be cleaned and sanitized on a regular basis. Areas should be monitored to avoid any moisture build-ups. It is important that refrigeration units are cleaned and sanitized and when applicable, filters replaced to avoid a build-up of mould spores. When selecting cleaning and sanitizing agents, look for food-grade products which inhibit mould growth.

SUMMARY

Given the right conditions, mould growth is a potential on shell eggs. However, following appropriate sanitation programmes and controlling temperature and relative humidity can prevent or reduce its occurrence.

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