Why does jam go mouldy, even in the fridge?

We have all, at some time, reached for the half used jar of jam hidden at the back of the cupboard only to find a soft furry layer of mould where once was clean, glistening, preserved fruit. Often the colonies are green, the colour imparted by pigmented spores, usually filamentous species such as *Aspergillus glaucus*. Sometimes we see slimy patches which are formed by contaminating yeasts such as *Saccharomyces rouxii, Debaryomyces hansenii* or *Torulopsis* spp.

Fungal spoilage, particularly of soft fruit, occurs very rapidly under normal, conditions. The fruit is full of water and nutrients which microbes can use and and acidity levels are high so that the growth of fungi is favoured. Fruit can be preserved by making jam, by freezing or by drying. In jam making the fruit is heated which softens it and also kills yeasts, fungi and other microbes which are naturally present on the surfaces of the fruit. Then sugar is added, in large amounts, and the jam subsequently packed into sterilised jars and sealed. In this way most microbes have been killed and are then excluded.

The addition of sugar, apart from improving the taste of the fruit, effectively reduces the amount of water which is available for the use of any remaining, or subsequently introduced microbes. The amount of water available in a particular environment is best expressed as **water activity**. Water activity is effectively reduced when a solute (e.g. sugar) is dissolved in water; some of the water is bound to the solute and is therefore unavailable. The water activity of pure water is 1.0 and goes down to zero when absolutely no water is available. Plants tend to wilt when water activity in soil reaches 0.98; maple syrup has a water activity of 0.90, jam 0.80 and dried fruit 0.7. A few fungi can survive water activity as low as 0.65 so if any of these find their way into the pot after opening they may be able to grow. Drying of fruit also works well for the same reason, although some fungi are very resistant to desiccation (xerophiles).

Sealing full jars when still warm from sterilisation limits the amount of air above the surface and therefore also limits the amount of oxygen. Once the jar has been opened however, oxygen is no longer limited and additionally potential contaminating microbes are admitted. Fungi which grow on the surface of jam, often yeasts, are resistant to high levels of sugar (osmotolerant species) or may even prefer such conditions (osmophilic species) and these usually grow on the syrup which leaks from the partly used fruit solids. Some osmophilic yeasts can grow by fermentation under very low levels of oxygen.

In these days of 'calorie consciousness' and 'dental health awareness' low sugar jams are popular. These are particularly vulnerable to fungi and yeasts which can tolerate low water activity. It is usually suggested that these products are stored in the fridge (4°C) after opening. However, some fungi are able to grow well just above freezing and their growth rate may be little reduced in these conditions. Some cold tolerant fungi can grow even below freezing (psychrophiles). Freezing, also lowers the water activity of the foodstuff, i.e. reduces the amount of water available for use by microbes that may be present (reducing the temperature of pure water to −15°C lowers the water activity from 1.0 to 0.86). Under such conditions the growth of contaminants is restricted although it is likely to resume under normal conditions (one reason why thawing and refreezing is not recommended). Temperatures of −15°C are usually sufficient to limit the growth of most fungal contaminants, including cold tolerant species, as a result of the reduction in water activity.

The lack of available water and reduced levels of oxygen will probably limit fungal growth to the topmost levels but I strongly suggest you consume the jar at its best in the aid of self preservation.

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