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CAUSE AND CONTROL OF HYDROLYTIC RANCIDITY IN RAW MILK

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Introduction

One of the common and important off-flavors in milk is hydrolytic rancidity or lipolyzed flavor. The rancidity results from hydrolytic cleavage of fatty acids from milk fat by the enzyme lipase and their release as free acids. The release of these acids in milk, even in very small amounts, imparts a bitter taste and a sharp, unpleasant aroma. The off-flavor is often described as "goaty", "butyric", "soapy", and "bitter." The term "bitter", however, is ambiguous because bitter flavors can occur from the result of protein breakdowns. Nevertheless, both farm and dairy plant problems may lead to its development. Once an objectionable level is reached, no processing technique will eliminate it.

Conditions Favoring Rancidity Development

The enzyme lipase is not normally active as the milk leaves the cow. However, several conditions are known to make the enzyme active. Interactions between milk fat globules and the enzyme are believed to be crucial. Like an electric motor activating machinery, these interactions activate the enzyme and cause the rancidity reaction to take place. The conditions favoring enzyme activations are: 1) agitation and foaming; 2) cooling to refrigeration temperatures, rewarming to 60 to 90 °F, and recooling to refrigeration temperatures; 3) homogenization; 4) mixing raw and homogenized-pasteurized milk; and 5) presence of excessive residual detergents and/or sanitizers.

Milk from individual cows is known to differ in its tendency to develop rancid flavor. Milk is generally resistant to the development of the flavor, but milk from some cows is very susceptible to the activation treatments. Such milk is so susceptible that cooling alone causes rancidity. This kind of milk is not too common, but the phenomenon is known as "spontaneous" rancidity development. Several conditions are thought to stimulate production of milk highly susceptible even to mild activation treatments. These include: 1) Advanced lactation. Breeding schedules that allow most of the herd to come into late lactation at the same time pose a potentially serious rancidity problem. 2) Mastitis. 3) Dry winter feed. This is one reason why the off-flavor often occurs in winter. Milk from cows on pasture generally is less susceptible to rancidity. 4) "Heat" periods may cause an increase in susceptibility, but this is of short duration. 5) Any illness that results in a sudden drop in production may be followed by rancidity problems.

Control Measures

Whether or not these five factors are present to encourage rancidity development, controls must be continuously applied. The following measures are recommended.

1) Use only inflations that are in good condition. Cracks or holes permit entry air that can cause turbulence. Agitation and foaming result.

2) When installing pipeline milkers, keep the pipeline as close to the cows as possible. Air entering at the "claw" and bubbling up the milk hose is potentially hazardous. Pipelines above cows require long hoses and allow agitation to take place over a longer period of time.

3) If "in-line" strainers are used, be sure joints on either side are airtight before milking. Lines "broken" at this point at each milking may not be properly tightened.

4) Keep pipeline joints on the vacuum side airtight. Any leak is a source of trouble.

5) Minimize the number of "risers" in the line. When milk is raised to a higher level, turbulence and foaming occur if the line is not filled with milk. Risers in a "full" line will not be serious sources of activation.

6) Do not operate pumps and releaser systems continuously, if a full head of milk is not available at all times. Automatic control systems can be installed to activate pumps or releasers only when the milk jar is full. After the jar is emptied, the pump and releaser automatically shut off.

7) Minimize or eliminate splash as milk enters cans or bulk tanks.

8) Keep milk cold. The most common cause of rancidity is agitation and foaming, and the reaction progresses much faster at warm temperatures. Milk coming from a cow at body temperature is highly reactive. Rapid cooling is essential.

9) Shut off vacuum while transferring milking machine to the next cow. Keep sufficient vacuum to prevent milking machines from falling off cows.

10) Feed adequate levels of good quality feed. Undernourished cows may produce susceptible milk.

11) Avoid excessive residual detergents and sanitizers in the system at the time of milking.