



## On-Farm Pasteurization of Milk for Calves

Matt Jorgensen and Pat Hoffman

### Introduction

All dairy operations have a supply of milk that is not saleable, commonly called waste milk. Waste milk can be defined as excess colostrum, non-saleable transition milk, mastitic milk or non-saleable antibiotic treated milk. In the past, waste milk was commonly fed to calves but concerns with bacteria contamination such as E.coli and salmonella as well as larger concerns with possible transmission of diseases such as Mycobacterium paratuberculosis (Johnes) through feeding waste milk have led to a general recommendation not to feed raw waste milk to calves.

Pasteurization of waste milk for calves is one option to reduce management risk while utilizing a valuable low cost liquid feed source for calves. Milk has been pasteurized for human consumption for many years, but milk pasteurization equipment and technology has been relegated to dairy plants bottling milk or producing dairy products for human consumption. Currently, companies are starting to produce, smaller, self-contained, on-farm pasteurizers specifically for the utilization of waste milk to feed to calves. These smaller on-farm pasteurizers are being marketed at prices that now make the technology affordable to an individual dairy operation to consider.



### How Pasteurization Works

Pasteurization was named after Louis Pasteur whom discovered that simple heating could inactivate spoilage organisms in wine. The process was later transferred to other commodities such as milk. The actual definition of pasteurization is; the heating of every particle of milk to a specific temperature for a specific time to reduce undesirable enzymes and bacteria to negligible levels. It is important to understand the pasteurization is not total sterilization of the milk. It is also important to note that pasteurization is function of time and temperature not just temperature.

Listed in the table are the time and temperature guidelines set forth for human consumption.

Temperature(°F)	Time
145	30 min
161	15 sec
191	1 sec
194	.5 sec
201	.1 sec
204	.05 sec
212	.01 sec

It should be noted that pasteurization temperatures for milk containing a high fat content (10 %) should be increased 5° F. This scenario can be very typical for waste milk that can be very high in fat content.

Typical on-farm applications for pasteurization of waste milk for calves involve homemade batch pasteurization systems or commercially produced continuous-flow (CF)/flash/high temperature, short time (HTST) pasteurizers. Commercially produced CF pasteurizers feature a heating system with 1 to 15 second retention time, cooling reservoir tank and clean in place (CIP) systems. Specific pasteurizers are also being marketed for the pasteurization of colostrums.

Typically, non-agitated batch pasteurizers and CF pasteurizer do not work very well for colostrums because colostrum has a tendency to thicken and flow poorly when heated to pasteurization temperatures. Despite altered physical characteristics, the immunoglobulins and growth factors in colostrums have been shown to be completely bioactive after careful pasteurization.

Generally, newly available on-farm waste CF pasteurization units heat milk to 162° F for 15 seconds. Clinical studies have shown that this combination is effective at killing the bacteria such as Staphylococcus,

Streptococcus, Salmonella, E. Coli, Listeria, and the Johnes organism Mycobacterium paratuberculosis, as well as most Mycoplasma bacterium.

It is important to note that pasteurization does not kill all the bacteria, but it reduces numbers of organisms present to extremely low levels. Despite its effectiveness, extremely contaminated or notable abnormal milk should be discarded and not pasteurized because its nutritional characteristics for calves cannot be assured.

## Potential Benefits

A benefit to on-farm commercial waste milk pasteurizers is that they are becoming relatively easy for users to operate, clean, and maintain. Control systems are simple and easier to understand and installation is not complex. On-farm pasteurizers are relatively small, taking up the space of a small milk bulk tank. Calf nutrition is relatively unaltered by feeding pasteurized milk. In research trials at the University of California-Davis, feeding pasteurized milk resulted in calves having fewer days of scours and pneumonia, when compared to non-treated milk. Pasteurized waste milk will contain more protein (25-30%) and fat (25-35%) on a dry matter basis than a standard 20% protein, 20% fat milk replacer; thus pasteurized waste milk is more energy dense on a dry matter basis than typical milk replacers.

## Potential Problems

Dairy operations have to consider their supply of waste milk. To be practically effective a dairy operation must have a stable supply of waste milk. A stable supply of waste milk is critically important because the liquid feed fed to calves should not be changed frequently. For smaller herds this is sometimes difficult because days or weeks can go by where there is no waste milk at all. Quality control is also an issue that demands constant attention. Milk pasteurizers need to be operated, evaluated, and maintained so a quality product is produced. Milk pasteurizers are also an investment requiring a return on investment.

Additionally, little is known about the effects of pasteurization on antibiotic residues in milk. Some antibiotics are heat sensitive and maybe rendered inactive other antibiotics are not. Calves fed pasteurized waste milk maybe contaminated with antibiotic residue and would be un-saleable as result until after the appropriate withholding periods. Finally, little is known

about the long term feeding aspects and risk associated with feeding pasteurized waste milk.



## What About Calf Health

There are two aspects of feeding pasteurized waste milk on calf health that need to be considered. First, feeding pasteurized waste milk has been demonstrated to improve calf health as compared to feeding raw waste milk. In a California study, calves fed pasteurized waste milk had lower incidence of scours and pneumonia; labor cost to treat calf

diseases was also lower. The potential to have an acute disease outbreak in calves should be greatly reduced if waste milk is pasteurized as compared to feeding raw waste milk.

Calf health aspects of feeding pasteurized waste milk as compared to feeding milk replacer have not been well defined. Assuming a high quality milk replacer is fed to calves, there would be no apparent logic to suggest any major differences in the incidence of calf disease between calves fed milk replacer or pasteurized waste milk. Calves fed typical pasteurized waste milk feeding rates (2 quarts/feeding) will consume significantly more energy and protein as compared to a typical feeding rate of 1.0 lb DM/calf/day of a 20:20 milk replacer (2 quarts/feeding). Calves on higher plane of nutrition are less likely to succumb to mal-absorption during scours events. Milk replacers; however, can and are being reformulated and fed at different rates to optimize nutrient intakes.

## Pasteurizer Set-Up

Currently available flash pasteurizers are easy to set-up and are generally self-contained. Units generally require a dedicated circuit at 240 volt, and a 50-80 amp receptacle (depending on the size of the unit). Water is also required for the pasteurization unit. A drain is also required to dispose of water and cleaning solutions. No hard plumbing is typically required to set up the unit.

The methods of heating milk to pasteurization temperature will determine the water temperature that is needed. If pasteurization temperature is achieved electrically, water needs to enter the unit at 95-115° F to cool the milk after pasteurization.

However, some units reach pasteurization temperature using water. These units require a dedicated water heater that will reach pasteurization temperature. Typically, units that use a water-heat exchanger will have



a feedback loop to cool milk that has been pasteurized. A lower cost option is to let the milk air cool.

Because bacteria can survive on debris like hay, manure, and insects, most units now include a filter screen for unpasteurized milk. It is vitally important, from a quality control standpoint, that this screen be in place whenever raw milk is put into the machine. In addition, waste milk should be properly refrigerated and kept as hygienic as possible prior to pasteurization.

Clean up of the units is not unlike cleaning milking equipment. A hot water, alkaline wash followed by an acid rinse is typical. The hot water used for washing needs to be supplied at 135-145° F. This water is typically supplied from a sink or exterior hose, not the water supply that is needed during pasteurization. Some units may offer an automated cleaning cycle, others require hand washing of some components.

## Economics

The price range for on-farm waste milk pasteurizers is variable. Cost is dependant on the size of and capacity of the pasteurizer, as well as the manufacturer. At the time of this publication (10/10/02) a 20-gallon continuous flow pasteurizer that could feed up to 40 calves if operated 2X/ day would cost approximately \$8,000 including a collection tank to hold pasteurized milk. The daily operating cost needs to be considered when evaluating on-farm waste milk pasteurizers. Operating costs include: electricity, chemicals, labor, and repairs.

To date there is little long-term economic data regarding cost to operate an on-farm waste milk pasteurizer. Some industry data indicates a cost of \$0.067 to \$0.46 per calf per day to operate a pasteurizer on waste milk. In general, daily operating and long term investment cost decline with increased calf numbers, therefore the technology is not size neutral.



Two commercially available on-farm waste milk pasteurizers

## Tips for Success

- Routinely culture samples of pasteurized milk to monitor quality.
- Train all employees that will be using the pasteurizer to be sure they understand how to operate the unit and what the concepts of pasteurization is.
- Conduct follow-up training and review for employees
- Do not pasteurize extremely abnormal milk because nutritional characteristics may be altered
- If calf death loss occurs, diagnose calf morbidities and mortalities.
- Know how to manually check the temperature of pasteurized milk to ensure proper temperatures are being met.
- Visit other operations successfully using on-farm waste milk pasteurization systems.

## The Bottom Line

Pasteurizing waste milk can provide an opportunity to produce a low-cost, high-value liquid feed for calves, which if managed properly has the potential to substantially reduce the cost of rearing calves. Quality control, routine maintenance, and proper utilization of the waste milk are essential to ensuring the safety of milk for calves. As commercial units come down in price, more dairy operations may find it economical to install a pasteurizer on-farm. The decision process should weigh all of the advantages and disadvantages of milk pasteurization.

## For More Information:

University of Wisconsin—Johne's Information Center  
<http://www.johnes.org>

Bettermilk Pasteurizing Systems  
1-877-356-6455  
<http://www.bettermilk.com>

Goodnature Products, Inc.  
1-800-875-3381  
<http://www.goodnature.com>

