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Calf Note #148 – Supplementing waste milk

Introduction

Waste milk is a common source of nutrients for preweaned calves. It is cheaper than whole milk, generally available and has few other productive uses. Waste milk has been used to feed calves for many years. Researchers have evaluated the value and risks associated with using waste milk, especially regarding bacterial contamination (Selim and Cullor, 1997) and economics (Jamaluddin et al., 1996; Godden et al., 2005). Several Calf Notes are available that discuss various aspects of waste milk, including [Calf Note #8](#) (Can I use waste milk for my calves?), [Calf Note #35](#) (Risks of using waste milk), [Calf Note #98](#) (What is the true cost of waste milk?), [Calf note #110](#) (Pasteurizing waste milk – an objective study), [Calf Note #144](#) (Milk pasteurization – more is not always better) and [Calf Note #146](#) (Waste milk vs. milk replacer, revisited).

Variation in waste milk solids

Normal whole milk should have approximately the following composition: solids 12.5%; protein 3.2%; fat 3.7%; lactose 4.6%. Of course, content can vary somewhat depending on diet, season and many other factors.

Composition of waste milk can vary from that of normal milk. In a recent study, Moore and coworkers (2009) reported that calf raisers don't always get what they expect in terms of nutrients when they feed waste milk.

A little background

Waste milk used to feed calves on large ranches is collected at dairies and stored until it is collected by the ranch. This usually occurs daily when the ranch workers come to the farm to collect newborn calves. Milk from several farms can be collected, pooled and transported back to the ranch for processing.

Bacteria can grow rapidly in waste milk. Further, the milk may contain mastitis pathogens, fecal coliforms and other infectious agents. Finally, equipment and procedures for handling waste milk may not be cleaned as thoroughly as for saleable milk. Thus, it's essential that waste milk be pasteurized prior to feeding. Most ranches use pasteurizers as a normal protocol to reduce bacterial counts and improve biosecurity.

Variation in nutrients in waste milk

Moore et al. (2009) found large variation in solids content in waste milk collected at dairies. The solids and somatic cell counts are in Table 1. Six of the samples were between 12.5 and 13%, indicative of normal composition. The other six samples had solids content less than normal milk, indicating that the milk had been diluted to some degree. In the case of samples 8 and 10, the dilution was great – solids of those samples were only 5.1 and 6.7%, respectively.

Why so dilute?

Why would some waste milk have so little solids? The short answer is water. It's likely that these farms were adding water (probably wash water) to the milk prior to sending it to the calf ranch. Adding water increases volume that can be sold, but decreases the nutrients available to the calf.

Note that one sample - #11, actually had solids content greater (though slightly) than that of normal milk. This could be due to inclusion of colostrum in the waste milk, which is thicker (more solids) than milk. First milking colostrum averages about 28% solids (Kehoe et al., 2007).

The bottom line regarding solids is that there is a lot of variation in waste milk. Indeed, waste milk can vary from farm to farm and from day to day. This makes the job of managing incoming waste milk more difficult and can lead to unacceptable variation in calf performance.

The solution to dilution

One approach taken to monitor variation in solids content of incoming waste milk is to use a BRIX refractometer. Refractometers are used to monitor concentration of solutes in a liquid sample; BRIX refractometers monitor solids content of liquids and are widely used in wine, sugar and other industries. In the case of waste milk, a BRIX refractometer can satisfactorily estimate solids in waste milk. Moore et al. (2009) estimated that a standard BRIX refractometer underestimated waste milk solids by about 2 percentage units – i.e., if the BRIX refractometer reported 10% solids, the actual solids in waste milk was about 12%.

Variation in total solids also implies variation in nutrients in waste milk. Table 2 estimates variation in waste milk protein, fat and lactose using the following assumptions (1) when solids content is <12.5%, the waste milk is diluted with water, which contains no nutrients; (2) when solids is >12.5%, waste milk contains colostrum, which contains 27.6% solids, 14.9% protein, 6.7% fat and 2.5% lactose (Kehoe et al., 2007).

Sample	Solids, %	SCC*
1	12.9	2.3
2	12.9	3.5
3	12.9	3.7
4	11.2	10.0
5	11.8	3.0
6	10.7	10.0
7	12.5	1.1
8	5.1	2.8
9	10.1	3.5
10	6.7	1.6
11	13.4	1.9
12	12.9	1.6
AVG	11.2	...

Table 1. Waste milk solids and somatic cell (SCC) counts (*million/ml). From: Moore et al., 2009.

We can also use the estimated nutrient content of waste milk using Table 2 to predict nutrient intake and compare that to an “optimal” intake using normal (12.5% solids) milk as a reference.

Comparison to whole milk

If we look at Table 2, we see that waste milk containing 11% solids will be about 2.8% protein, 3.3% fat and 4.0% lactose. Thus, if we feed 11% solids waste milk, we provide only 88% of the dry matter, protein, fat and lactose that calves would receive if fed an equivalent amount of normal milk. Thus, we should supplement the waste milk to increase nutrient content and reduce nutrient variation.

Solids	Protein		Fat		Lactose	
	Liquid	DM	Liquid	DM	Liquid	DM
15.0%	4.5%	30.3%	4.3%	28.7%	4.8%	32.2%
14.0%	4.0%	28.4%	4.1%	29.1%	4.8%	34.0%
13.0%	3.5%	26.5%	3.8%	29.4%	4.7%	35.9%
12.5%	3.2%	25.6%	3.7%	29.6%	4.6%	36.8%
12.0%	3.1%	25.6%	3.6%	29.6%	4.4%	36.8%
11.0%	2.8%	25.6%	3.3%	29.6%	4.0%	36.8%
10.0%	2.6%	25.6%	3.0%	29.6%	3.7%	36.8%
9.0%	2.3%	25.6%	2.7%	29.6%	3.3%	36.8%
8.0%	2.0%	25.6%	2.4%	29.6%	2.9%	36.8%

Table 2. Composition of protein, fat and lactose in waste milk diluted with water (<12.5% solids) or containing colostrum (>12.5% solids).

Supplementing waste milk

Many producers utilize calf milk replacer (**CMR**) to increase the nutrient content of their waste milk. Table 3 shows an example of the changes in nutrients fed when we add 41 lbs of a 20/20 CMR to 300 gallons of waste milk. In this example, milk + CMR provide 283 and 39 lbs of solids, respectively, which exactly matches the solids in 300 gallons of whole milk (322 lb). In addition, the mixture of waste milk + CMR provides 81 lbs of protein and 92 lbs of fat, which are both slightly below the nutrient content of whole milk (82 and 95 lb, respectively). Finally, the amount of lactose in the mix is greater than the lactose in whole milk.

	Solids		Protein		Fat		Lactose		
	lbs	%	lbs	%	lbs	%	lbs	%	
Waste milk	2,576	11.0%	283	2.8%	73	3.3%	84	4.0%	104
CMR	41	95.0%	39	20.0%	8	20.0%	8	50.0%	21
	2,617	12.3%	322	25.1%	81	28.6%	92	38.7%	125
Whole milk:	12.5%	322	25.6%	82	29.6%	95	36.8%	118	
% of milk:		100%		98%		97%		105%	

Table 3. Evaluation of nutrient intake when waste milk (11% solids) is supplemented with 41 lbs of a CMR containing 20% protein and 20% fat.

Should we want to provide a more nutritionally complete feed for calves, we need to change the nutrient content of the feed used to supplement waste milk. Table 4 shows that a supplement containing 24% protein, 28% fat and 34.6% lactose will match exactly the nutrient profile of milk containing 12.5% solids. Producers who are interested in getting maximal performance from their calves should consider a formulation with more protein and fat and less lactose than a 20/20 CMR. A 24/28/35 formulation (as in Table 4) will exactly match nutrients needed by

the calf regardless of the solids content of the waste milk – assuming that the amount is increased to meet solids intake.

	Solids			Protein		Fat		Lactose	
	lbs	%	lbs	%	lbs	%	lbs	%	lbs
Waste milk	2,576	11.0%	283	2.8%	73	3.3%	84	4.0%	104
CMR	41	95.0%	39	24.0%	8	28.0%	8	34.6%	21
	2,617	12.3%	322	25.6%	82	29.6%	95	36.8%	118
Whole milk:		12.5%	322	25.6%	82	29.6%	95	36.8%	118
% of milk:			100%		100%		100%		100%

Table 4. Evaluation of nutrient intake when waste milk (11% solids) is supplemented with 41 lbs of a CMR containing 24% protein and 28% fat.

The vitamin question

Another consideration when using commercial CMR to supplement waste milk is the amount of vitamins provided. Commercial CMR are formulated to provide at least the NRC requirements for vitamins and minerals, but may not provide the right kind of vitamin and mineral supplementation to properly fortify waste milk. Table 5 shows the vitamin and mineral recommendations for commercial CMR obtained from the 2001 NRC Nutrient Requirements for Dairy Cattle as well as typical composition of vitamins and minerals in whole milk. These values are NOT corrected for dilution effects.

As can be seen from Table 5, the NRC requirements for the calf and vitamin / mineral content of whole differ. Therefore, a specific supplement containing the correct amounts of vitamins and minerals is needed to properly supplement waste milk. Simply using a commercial CMR will not provide the correct proportions of important vitamins and minerals, particularly when a CMR is added at relatively small amounts per day. In the example Table 3, calves are fed 300 gallons of waste milk plus 41 lbs of CMR. If this milk is fed to 300 calves, the amount of CMR fed per calf is $41 / 300 = 0.14$ lbs/day, or about 10% of a normal feeding of CMR powder. Thus, calves would receive only about 10% of the vitamins normally provided in a CMR. Clearly, using a commercial CMR to supplement waste milk will provide incomplete nutrition to young milk-fed calves.

What's being used on the farm

Producers have a number of options available to supplement waste milk to increase its nutrient content and improve calf growth. There are a few categories of products intended for different purposes.

Commercial CMR. As I've outlined, though commercial CMR is a common way to increase the solids content of waste milk, it is not optimal. A standard 20/20 CMR contains too little protein, fat, vitamins and minerals and too much lactose to optimally supplement waste milk. However, CMR is widely available, easy to use and is recommended by many dairy professionals.

Vitamin supplements. Some commercial products are available to increase the vitamin / mineral content of waste milk. These products are fed at a rate of a few grams per day and do not increase solids, fat or protein.

Protein supplements. Some producers add CMR plus additional protein to increase both the solids and protein content of waste milk. Proteins sources include whey protein concentrate and spray-dried animal plasma. Adding plasma to waste milk has the advantage of providing functional proteins such as IgG which can help maintain normal intestinal immune function and reduce the risk and severity of diarrhea in young calves.

Complete supplements. There are few supplements specifically formulated to supplement waste milk on the farm. A nutritionally complete product would be higher in protein, fat, vitamins and minerals and lower in lactose than a typical CMR. Using the assumptions in this Calf Note, a supplement containing 24% crude protein, 28% fat and 35% lactose plus proper vitamin and mineral supplementation would precisely meet the nutrient requirements of milk-fed calves.

Summary

We continue to improve our understanding of the feeds we provide to young calves. Variation in waste milk nutrient content is an important source of variation and can explain at least some of the variation we see in calf growth on the farm. Proper supplementation requires a more sophisticated nutritional approach than simply adding commercial CMR to waste milk. Formulation of products specifically designed for this task will improve our ability to raise calves using waste milk as a nutrient source.

Units	Nutrient	NRC	Milk (DM)	% of NRC
%	Ca	1	0.9	90%
	P	0.7	0.8	107%
	Mg	0.1	0.1	100%
	K	0.65	1.4	215%
	Na	0.4	0.4	100%
	Cl	0.25	0.8	320%
ppm	Zn	40	34.0	85%
	Mn	40	0.4	1%
	Fe	100	5.0	5%
	Cu	10	0.8	8%
	I	0.5	0.2	30%
	Se	0.3	0.2	67%
IU/kg	Co	0.1	0.0	9%
	A	9,000	9,500	106%
	D	600	200	33%
ppm	E	50	6.0	12%
	Thiamin	6.5	2.9	45%
	Riboflavin	6.5	12.4	191%
	Niacin	10	6.6	66%
	Pantothen.	13	23.3	179%
	Pyridoxine	6.5	3.1	48%
	Folic acid	0.5	0.6	120%
	B12	0.07	0.0	43%
	Biotin	0.1	0.3	300%
	Choline	1,000	1,204	120%

Table 5. NRC requirements for vitamins and minerals compared to composition of whole milk (uncorrected for dilution at different solids content).

Sources: 2001 NRC Nutrient Requirements for Dairy Cattle and USDA National Nutrient Database for Standard Reference: http://www.nal.usda.gov/fnic/foodcomp/cgi-bin/list_nut_edit.pl

References

Godden, S. M., J. P. Fetrow, J. M. Feirtag, L. R. Green, and S. J. Wells. 2005. Economic analysis of feeding pasteurized nonsaleable milk versus conventional milk replacer to dairy calves. *J. Am. Vet. Med. Assoc.* 226:1547–1554.

Jamaluddin, A. A., T. E. Carpenter, D. W. Hird, and M. C. Thurmond. 1996. Economics of feeding pasteurized colostrum and pasteurized waste milk to dairy calves. *J. Am. Vet. Med. Assoc.* 209:751–756.

Kehoe, S. I., B. M. Jayarao, and A. J. Heinrichs. 2007. A survey of bovine colostrum composition and colostrum management practices on Pennsylvania dairy farms. *J. Dairy Sci.* 90:4108–4116.

Moore, D. A., J. Taylor, M. L. Hartman, and W. M. Sischo. 2009. Quality assessments of waste milk at a calf ranch. *J. Dairy Sci.* 92:3503-3509.

Selim, S. A., and J. S. Cullor. 1997. Number of viable bacteria and presumptive antibiotic residues in milk fed to calves on commercial dairies. *J. Am. Vet. Med. Assoc.* 211:1029–1035.

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