A survey of dairy goat kid rearing practices on Canadian farms and their associations with self-reported farm performance

S. Bélanger-Naud,* D. Cinq-Mars,† C. Julien,‡ J. Arsenault,# S. Buczinski, § J. Lévesque,‡ and E. Vasseur*[1]

* Department of Animal Science, McGill University, Sainte-Anne-de-Bellevue, Quebec, H9X 3V9, Canada

† Département des sciences animales, Université Laval, Québec, Quebec, G1V 0A6, Canada

‡ Centre de recherche en sciences animales de Deschambault, Deschambault, Quebec, G0A 1S0, Canada

Département de pathologie et microbiologie, and

§ Département des sciences cliniques, Faculté de médecine vétérinaire de l'Université de Montréal, Saint-Hyacinthe, Quebec, J2S 2M2

[1]Corresponding author: elsa.vasseur@mcgill.ca

SUPPLEMENTAL MATERIAL

Supplemental Table S1. Statistically significant associations between farm performance indicator milk production (litres/goat/305 days) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Milk production			Univariable regression coefficient		
		Mean	SD[2]	Range	β[3]	95 % CL[4]	P-value
Colostrum feeding							
Time of first colostrum feeding							
> 2 hours after birth	17	793	211	684-902	Referent	--	--
≤ 2 hours after birth	55	915	185	865-965	122.02	16.28, 227.75	0.024
Pooled colostrum							
Yes	29	825	195	750-899	Referent	--	--
No	25	949	173	878-1020	124.38	23.09, 225.67	0.017
Milk feeding							
Use of a trough feeder for milk[5]							
No	80	888	193	846-931	Referent	--	--
Yes	7	724	95	635-812	-164.76	-311.54, -17.98	0.028
Solid feeding							
CP[6] content of concentrates, %	65	--	--	--	17.61	1.37, 33.85	0.034
Health management							
Medication in milk							
Never	35	817	224	740-894	Referent	--	--
When necessary or in prevention	52	910	158	866-954	92.45	11.09, 173.81	0.026
Add coccidiostats in concentrates							
No, or when necessary	25	765	190	686-843	Referent	--	--
Yes, in prevention	59	909	165	866-952	144.12	62.22, 226.03	<0.001
Disbudding							
Time of disbudding							
≥ 3 weeks of age	22	788	188	705-872	Referent	--	--
≤ 2 weeks of age	49	906	189	852-960	117.45	21.02, 213.89	0.018
Use of pain control for disbudding							-
No	51	823	193	769-877	Referent	--	-
Yes	31	943	168	881-1005	119.89	36.54, 203.23	0.005
Record keeping							
Milk recording							
No	78	838	182	797-879	Referent	--	--
Yes	13	1048	160	951-1144	209.49	103.01, 315.98	<0.001
Record keeping for kid rearing							
No	19	757	133	692-821	Referent	--	--
Yes	69	898	795	851-945	141.62	47.01, 236.24	0.004
Record treatments given to kids							
No	30	836	203	760-912	Referent	--	--
Yes	37	935	165	880-990	98.82	9.26, 188.38	0.031
Weigh kids at birth							
No	59	827	159	786-869	Referent	--	--
Yes	24	946	227	850-1042	118.94	31.78, 206.11	0.008

[1]Number of herds.
[2]Standard deviation
[3]Regression coefficient
[4]95 % confidence interval
[5]Respondents could select more than one option

22 [6]Crude protein

Supplemental Table S2. Statistically significant associations between farm performance indicator preweaning mortality rate (%) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Preweaning mortality rate		Univariable regression coefficient		
		Mean[2]	Range[2]	β[3,4]	95 % CL[4,5]	P-value
Kidding management						
Kidding monitoring in the day						
≤ 2 times/day	26	15.3	9.4-22.3	Referent	--	--
> 2 times/day	60	8.6	6.1-11.5	-0.10	-0.198, -0.011	0.029
Kidding monitoring at night[6]						
Never	32	12.9	8.7-17.8	Referent	--	--
At least once	55	7.8	5.3-10.7	-0.09	-0.167, -0.003	0.042
Use video cameras for monitoring						
No	89	10.9	8.5-13.6	Referent	--	--
Yes	7	2.2	0.1-7.0	-0.19	-0.337, -0.039	0.014
Separation of kid from dam						
After first suckling > 50 % of the times	35	13.7	9.0-19.1	Referent	--	--
Before first suckling > 50 % of the times	60	8.3	6.0-11.0	-0.09	-0.167, -0.006	0.035
Colostrum feeding						
Time of first colostrum feeding						
> 2 hours after birth	17	20.0	12.7-28.4	Referent	--	--
≤ 2 hours after birth	55	7.6	5.1-10.5	-0.18	-0.289, -0.081	<0.001
Quantity of colostrum fed in first 12 hours, litres	65	--	--	-0.30	-0.518, -0.090	0.006
Milk feeding						
Number of kids per nipple on the bucket[7]						
> 1 kid/nipple	16	13.8	6.6-23.2	Referent	--	--
≤ 1 kid/nipple	29	5.1	2.9-7.8	-0.15	-0.267, -0.040	0.009
Health management						
Time of umbilical cord disinfection[8]						
> 2 hours after birth	7	21.4	7.7-39.7	Referent	--	--
≤ 2 hours after birth	57	9.1	6.3-12.4	-0.17	-0.335, 0.014	0.033
Give Selenium + Vit. E to pregnant goats						
No	64	12.1	9.3-15.2	Referent	--	--
Yes	25	6.5	2.7-11.7	-0.10	-0.188, -0.007	0.036

[1]Number of herds
[2]Mean and range were back-transformed to facilitate interpretation of results. No standard deviation is presented since it is not appropriate to back-transform to the same scale.
[3]Regression coefficient
[4]Regression coefficient and 95 % CI are presented on the Arcsine scale since it is not appropriate to back-transform those values
[5]95 % confidence interval
[6]Monitoring after night chores
[7]Only those who feed milk in a milk bucket
[8]Only those who disinfect

Supplemental Table S3. Statistically significant associations between farm performance indicator replacement rate (%) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Replacement rate		Univariable regression coefficient		
		Mean[2]	Range[2]	β[3,4]	95 % CL[4,5]	P-value
Colostrum feeding						
Evaluate colostrum quality						
No	24	15.6	11.1-20.6	Referent	--	--
Yes	24	23.3	17.4-29.8	0.10	0.003, 0.194	0.043
Milk feeding						
Use of a trough feeder for milk[6]						
No	73	18.6	15.6-21.7	Referent	--	--
Yes	7	30.4	22.0-39.6	0.14	0.009, 0.269	0.037
Milk type						
Fresh cow or pasteurized goat milk	7	9.7	2.0-22.4	Referent	--	--
Kid or calf milk replacer	60	21.0	14.5-24.8	0.16	0.021, 0.296	0.025
Fresh goat milk	4	14.3	5.9-25.7	0.07	-0.145, 0.287	0.514
Disbudding						
Time of disbudding						
≥ 3 weeks old	23	32.6	22.4-43.7	Referent	--	--
≤ 2 weeks old	48	17.2	13.5-21.2	-0.18	-0.286, -0.074	0.001
Housing						
Kids are housed with dams until weaning						
No	78	19.5	16.5-22.6	Referent	--	--
Yes	5	50.3	2.4-97.8	0.33	0.146, 0.517	<0.001

[1]Number of herds

[2]Mean and range were back-transformed to facilitate interpretation of results. No standard deviation is presented since it is not appropriate to back-transform to the same scale.

[3]Regression coefficient

[4]Regression coefficient and 95 % CI are presented on the Arcsine scale since it is not appropriate to back-transform those values

[5]95 % confidence interval

[6]Respondents could select more than one option

Supplemental Table S4. Stastistically significant associations between farm performance indicator kid diarrhea prevalence (%) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Diarrhea %		Univariable regression coefficient		
		Mean[2]	Range[2]	β[3,4]	95 % CL[4,5]	P-value
Kidding management						
Number of kidding periods						
< 3 periods/year	32	6.3	3.3-10.2	Referent	--	--
≥ 3 periods/year	63	17.8	11.9-24.6	0.18	0.056, 0.308	0.005
Colostrum feeding						
Time of first colostrum feeding						
> 2 hours after birth	18	23.9	9.4-42.5	Referent	--	--
≤ 2 hours after birth	56	10.9	6.8-15.8	-0.17	-0.339, -0.008	0.040
Quantity of colostrum fed in first 12 hours, L	66	--	--	-0.38	-0.718, -0.044	0.027
Milk feeding						
Trough feeder space, cm/head	6	--	--	-0.02	-0.040, -0.003	0.034
Use of an automatic milk feeder[6]						
No	52	9.8	6.3-13.9	Referent	--	--
Yes	40	19.4	10.9-29.6	0.14	0.012, 0.263	0.032
Number of kids per nipple on the bucket[7]						
> 1 kid/nipple	16	18.9	9.3-31.1	Referent	--	--
≤ 1 kid/nipple	30	6.7	3.5-11.0	-0.19	-0.328, -0.048	0.010

[1]Number of herds

[2]Mean and range were back-transformed to facilitate interpretation of results. No standard deviation is presented since it is not appropriate to back-transform to the same scale.

[3]Regression coefficient

[4]Regression coefficient and 95 % CI are presented on the Arcsine scale since it is not appropriate to back-transform those values

[5]95 % confidence interval

[6]Respondents could select more than one option

[7]Only those who feed milk in a milk bucket

Supplemental Table S5. Statistically significant associations between farm performance indicator kid respiratory disease prevalence (%) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Respiratory disease		Univariable regression coefficient		
		Mean[2]	Range[2]	β[3,4]	95 % CL[4,5]	P-value
Kidding management						
Number of kidding periods						
< 3 periods/year	32	4.6	2.3-7.7	Referent	--	--
≥ 3 periods/year	63	10.2	6.4-14.7	0.11	0.003, 0.214	0.043
Kidding monitoring at night[6]						
Never	29	12.7	6.2-21.0	Referent	--	--
At least once	58	5.8	3.6-8.4	-0.12	-0.228, -0.017	0.024
Use video cameras for monitoring						
No	90	8.6	5.9-11.8	Referent	--	--
Yes	7	1.0	0.1-4.8	-0.20	-0.390, -0.009	0.040
Solid feeding						
Forages are made available…						
After 2 weeks of age	34	12.6	6.0-21.3	Referent	--	--
In first 2 weeks after birth	49	5.2	3.2-7.6	-0.13	-0.246, -0.022	0.019
Housing						
Kids are housed with dams until weaning						
No	91	8.6	5.9-11.7	Referent	--	--
Yes	6	0.6	0.5-5.0	-0.22	-0.426, -0.017	0.034
Buck kids raised on farm for 2 weeks or more						
No	49	5.3	3.0-8.1	Referent	--	--
Yes	47	11.4	6.7-17.1	0.11	0.014, 0.211	0.026

[1]Number of herds

[2]Mean and range were back-transformed to facilitate interpretation of results. No standard deviation is presented since it is not appropriate to back-transform to the same scale.

[3]Regression coefficient

[4]Regression coefficient and 95 % CI are presented on the Arcsine scale since it is not appropriate to back-transform those values

[5]95 % confidence interval

[6]Monitoring after night chores

Supplemental Table S6. Statistically significant associations between farm performance indicator average daily gain of kids from birth to weaning (g/day) and rearing practices based on self-reported data

Rearing sector/practice	n[1]	Average daily gain			Univariable regression coefficient		
		Mean	SD[2]	Range	β[3]	95 % CL[4]	P-value
Colostrum feeding							
Evaluate colostrum quality							
No	13	167.3	47.3	138.8-195.9	Referent	--	--
Yes	17	216.0	42.6	194.1-237.9	48.70	14.995, 82.397	0.006
Milk feeding							
Use buckets with nipples at the top[5]							
No	29	202.9	45.4	185.7-220.2	Referent	--	--
Yes	10	164.8	43.6	133.6-196.0	-38.08	-71.475, -4.690	0.027
Housing							
Kids grouped by age[5]							
No	7	151.0	39.0	114.9-187.1	Referent	--	--
Yes	33	201.0	44.5	185.2-216.8	50.00	13.233, 86.758	0.009
Record keeping							
Record kids' diseases							
No	19	171.6	43.9	150.4-192.7	Referent	--	--
Yes	14	213.1	35.9	192.4-233.8	41.53	12.283, 70.770	0.007

[1]Number of herds
[2]Standard deviation
[3]Regression coefficient
[4]95 % confidence interval
[5]Respondents could select more than one option

79 Supplemental Table S7. Spearman correlation coefficients between farm performance indicators
80 and farm characteristics from self-reported data on 104 dairy goat herds in Canada

Item	Milk prod.	Pre-weaning mortality	Replac. rate	Diarrhea[1]	Respiratory disease[1]	ADG[2] weaning	Herd size	Years in prod.	Breeding age
n	92	97	85	97	97	40	101	103	87
Milk production	1								
Preweaning mortality	-0.286**	1							
Replacement rate[1]	-0.073	0.119	1						
Diarrhea[1]	-0.112	0.375***	0.083	1					
Respiratory disease	-0.036	0.348***	0.175	0.260**	1				
ADG[2] to weaning	0.215	-0.131	0.226	-0.171	-0.259	1			
Herd size	0.033	0.229*	0.348**	0.033	0.308**	0.109	1		
Years in production	-0.018	-0.128	0.234*	-0.265**	-0.096	0.250	0.192	1	
Breeding age	-0.257*	-0.076	0.014	-0.043	-0.098	-0.016	-0.017	0.092	1

*indicates a $P \leq 0.05$; **indicates a $P \leq 0.01$; ***indicates a $P \leq 0.001$

[1]Prevalence

[2]Average daily gain from birth to weaning

81
82
83

Supplemental Table S8. Contribution to variance and coordinate of the variables to the principal components

Principal component	Variable	Partial contribution to variance (%)	Coordinate
PC1	Preweaning mortality rate	34.70	0.82
	Replacement rate	1.47	-0.17
	Milk production	15.97	-0.56
	Growth to weaning	21.58	-0.65
	% Diarrhea	21.71	0.65
	% Respiratory disease	4.57	0.30
PC2	Preweaning mortality rate	4.53	0.24
	Replacement rate	41.16	0.73
	Milk production	2.48	0.18
	Growth to weaning	20.90	0.52
	% Diarrhea	7.02	0.30
	% Respiratory disease	23.91	0.56

Supplemental Table S9. Frequency (number of respondents and percentage) of kid rearing practices on surveyed commercial herds (categorical, binary data used for analyses)

Kidding management	n	%
Number of kidding periods/year	101	
≤ 2 periods	35	35
> 2 periods	66	65
Kidding monitoring in the day	91	
≤ 2 times times/day	27	30
> 2 times times/day	64	70
Kidding monitoring at night	93	
Never	32	34
At least once	61	66
Use of video cameras for monitoring	102	
No	95	93
Yes	7	7
Separation of kid from dam	99	
After first suckling > 50 % of the times	35	35
Before first suckling > 50 % of the times	64	65
Kids left with dams to lick them dry[1]	102	
No	52	51
Yes	50	49
Kids dried manually (with use of heat lamp, towel, hair drier, heated foor, or other method)[5]	102	
No	36	35
Yes	66	65
Colostrum management (when hand-fed; n = 79; 77 % of respondents)	n	%
Time of first colostrum feeding	78	
> 2 hours after birth	18	23
≤ 2 hours after birth	60	77
Length of the colostral period	79	
≤ 24 hours	28	35
> 24 hours	51	65
Use of oesophageal tube when necessary	79	
No	62	78
Yes	17	22
Colostrum source2	79	
Goat colostrum	44	56
Cow colostrum	17	22
Bovine colostrum replacer (lyophilized)	45	57
Use of frozen colostrum	79	
Never	42	53
Sometimes or always	37	47
The following applies to those who feed fresh colostrum (i.e., not lyophilized colostrum):		
Thermize colostrum (heat treat at 56°C for 1 hour)	59	
No	35	59

Yes	24	41
Pool colostrum	58	
Yes	27	47
No	31	53
Evaluate colostrum quality	59	
No	29	49
Yes	30	51
Visually evaluate colostrum quality1	31	
No	10	32
Yes	21	68
Use refractometer to evaluate colostrum quality1	31	
No	22	71
Yes	9	29
Use colostrometer to evaluate colostrum quality1	31	
No	25	81
Yes	6	19
Milk feeding	n	%
Kids fed under dams until weaning	103	
No	97	94
Yes	6	6
Milk type	87	
Fresh goat milk	4	5
Milk replacer (kid or calf)	75	86
Fresh cow or pasteurized goat or cow milk	8	9
Acidified milk	92	
No	68	74
Yes	24	26
Milk from goats with antibiotics	93	
Yes	10	11
No	83	89
Use of milk bucket(s) with nipples at the bottom[1]	95	
No	76	80
Yes	19	20
Use of milk bucket(s) with nipples at the top[1]	95	
No	67	71
Yes	28	29
Use of a trough feeder to feed milk[1]	95	
No	88	93
Yes	7	7
Use of single nipple bottle(s) to feed milk[1]	95	
No	71	75
Yes	24	25
Use of an automatic milk feeding system (AMF)[1]	95	
No	54	57
Yes	41	43
Number of kids per nipple (for bucket feeding)	48	

> 1 kid/nipple	16	33
≤ 1 kid/nipple	32	67
Number of kids per nipple (for AMF feeding)	41	
> 10 kids/nipple	8	20
≤ 10 kids/nipple	33	80
Number of milk meals/day (non-AMF systems)	53	
2 meals/day	30	57
≥ 3 meals/day	23	43
Washing frequency of milk bucket (or trough feeder)	54	
Not at each use	19	35
At each use	35	65
Washing frequency of AMF	41	
Every 2 or more days	24	59
At least every day	17	41
Solid and water feeding	n	%
Time (age) of first concentrate availability	95	
≤ 2 weeks of age	51	54
> 2 weeks of age	44	46
Time (age) of first forage availability	85	
≤ 2 weeks of age	49	58
> 2 weeks of age	36	42
Time (age) of first water availability	87	
≤ 2 weeks of age	39	45
> 2 weeks of age	48	55
Health management	n	%
Umbilical cord disinfection frequency	103	
< 50 % of the time	50	49
≥ 50 % of the time	53	51
Time of umbilical cord disinfection	68	
> 2 hours after birth	7	10
≤ 2 hours after birth	61	90
Selenium and vitamin E administered to dams during gestation	94	
No	69	73
Yes	25	27
Selenium and vitamin E administered to kids at birth	94	
No	43	46
Yes	51	54
Vaccination of dams during gestation	98	
No	52	53
Yes	46	47
Vaccination of kids before weaning	99	
No	66	67
Yes	33	33
Coccidiostats in concentrates	95	
No, or when necessary	32	34
Yes, in prevention	63	66

Medication in milk	94	
Never	40	43
When necessary or in prevention	54	57
Disbudding	n	%
Time (age) of disbudding/dehorning	82	
In first 2 weeks of age	56	68
In the 3rd week or later	26	32
Use of pain control for disbudding	92	
No	59	64
Yes	33	36
Use of long-acting anti-inflammatory (> 24h) for disbudding[1]	92	
No	70	76
Yes	22	24
Use of short-acting anti-inflammatory (0-24h) for disbudding[1]	92	
No	86	93
Yes	6	7
Use of local anesthesia for disbudding[1]	92	
No	83	90
Yes	9	10
Use of a sedative for disbudding[1]	92	
No	88	96
Yes	4	4
Kid housing	n	%
Possible contact with adult goats and/or sharing same air (same barn)	97	
Yes	34	35
No	63	65
Buck kid management	102	
Not kept on farm more than 2 weeks	52	51
Raised on farm for 2 weeks or more	50	49
Group kids by age[1]	98	
No	28	29
Yes	70	71
Group kids by weight[1]	98	
No	47	48
Yes	51	52
Group kids by sex[1]	98	
No	52	53
Yes	46	47
Kids are housed with dams until weaning	99	
No	93	94
Yes	6	6
Number of kids per pen	89	
< 15 kids	52	58
≥ 15 kids	37	42
Bedding addition frequency[2]	80	

At least every day	30	38
Between every day and every 2 days	24	30
< Every 2 days (3,5 times/week)	26	5
Pen cleaning frequency	96	
Less than once a week	63	66
At least once a week (4 x/month)	33	34
Weaning	n	%
Weaning age	68	
< 8 weeks	31	46
≥ 8 weeks	37	54
Weaning weight	61	
< 15 kg	17	28
≥ 15 kg	44	72
Weaning criteria	92	
Age only	25	27
Weight only	20	22
Concentrate consumption only	3	3
Age & weight	33	36
Age & concentrate consumption	2	2
Weight & concentrate consumption	1	1
Age, weight & concentrate consumption	8	9
Weaning method	92	
Abrupt	36	39
Progressively (any progressive method)	56	61
Length of weaning period (if progressive)	60	
< 7 days	21	35
≥ 7 days	39	65
Record keeping	n	%
Milk recording	103	
No	89	86
Yes	14	14
Record keeping for kid management	99	
No	25	25
Yes	74	75
Record kid vigour at birth[1]	72	
No	59	82
Yes	13	18
Record kid identification at birth[1]	72	
No	3	4
Yes	69	96
Record parent identification at birth[1]	72	
No	5	7
Yes	67	93
Record kid mortality from birth to weaning[1]	72	
No	9	26
Yes	53	74

Record kid diseases between birth and weaning[1]	72	
No	49	68
Yes	23	32
Record treatments administered to kids[1]	72	
No	32	44
Yes	40	56
Record kid vaccination[1]	72	
No	42	58
Yes	30	42
Weigh kids at birth[1]	92	
No	67	73
Yes	25	27
Weigh kids between birth and weaning[1]	92	
No	81	88
Yes	11	12
Weigh kids at weaning[1]	92	
No	53	58
Yes	39	42
Measure kid height at some point until weaning (inclusively)	92	
No	88	96
Yes	4	4

[1]Those practices could be used in combination with another practice. Whether they used this practice or not does not mean they could not have used another one as well.
[2]Respondents could select more than one answer that applied to their situation, therefore the total prevalence (%) does not necessarily add up to 100 %.

Supplemental Table S10. Median and range of kid rearing practices on all commercial herds (continuous variables) from self-reported data

Rearing sector	n	Min[1]	P25[2]	Med[3]	P75[4]	Max[5]
Colostrum feeding						
Quantity fed in first feeding, mL	72	44	175	250	300	500
Quantity fed in first 12 hours of life, mL	69	89	450	600	754	1000
Milk feeding						
Milk replacer crude protein content (%)	60	19	22	22	22	26
Milk replacer fat (%)	56	17	22	23	25	28
Solid feeding						
Concentrate crude protein content (%)	72	14	18	20	22	27
Weaning						
Weaning age (weeks)	68	5	6	8	10	20
Concentrate consumption at weaning (g/day)	13	50	100	250	250	500
Length of the weaning period	60	1	5	7	10	21

[1]Minimum
[2]25th percentile
[3]Median
[4]75th percentile
[5]Maximum