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Survey of husbandry and health on UK commercial dairy goat farms

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Abstract

Published research relevant to the UK dairy goat industry is scarce. Current practices and concerns within the UK dairy goat industry must be better understood if research is to have optimal value. A postal survey was conducted of the farmer membership of the Milking Goat Association as a first step in addressing gaps in knowledge. Questions were asked about husbandry practices, farmer observations of their goats and their priorities for further research. Seventy-two point nine per cent of Milking Goat Association members responded, representing 38% of commercial dairy goat farms and 53% of the commercial dairy goat population in England and Wales. Findings were comprehensive and showed extensive variation in farm practices. Farmers reported pneumonia and scours (diarrhoea) as the most prevalent illnesses of their kids. Pneumonia, diarrhoea, failure to conceive and poor growth were the most prevalent observations of youngstock. Overly fat body condition, assisted kidding, failure to conceive and difficulty drying off were the most prevalent observations of adult milking goats.

Farmers top priorities for further research were kid health (79.5% of farmers), Johne's disease (69.5% of farmers), tuberculosis (59% of farmers) and nutrition (47.7% of farmers).

Introduction

There are an estimated 108,000 goats on agricultural holdings within the UK, with 92,000 goats located in England and Wales.[1] Approximately 46,000 are dairy goats commercially farmed in England and Wales, and located over 120 farms.[2] Here commercial farming is defined as the production of milk or milk-based products for sale for human consumption. The UK dairy goat industry is small and decentralised, compared to the UK dairy cattle industry. It is a relatively young industry, with large scale commercial farms developing mainly over the last 25 years. In 2017, UK dairy goat farmers formed an industry body, the Milking Goat Association, to better represent their interests, better communicate with each other and to support industry driven research.

To date, published studies of goat health, welfare and production are scarce, particularly those concerning UK dairy goats. Those that do report on the UK industry include our previous study which assessed the welfare of dairy goats on 24 UK commercial farms using animal-based measures and found lameness, claw overgrowth, skin lesions, udder and teat lesions to be particular problems.[3] Several studies of lameness and the causes of lameness have noted a very high prevalence on some farms.[4-7] Despite milk being the primary farm produce there have been only three studies of mastitis in commercial dairy herds[8-10] and one study estimating the breeding values for milk yield.[11] Scrapie is the best represented infectious disease with several epidemiological studies describing infection prevalence and scope for breeding disease resistant goats.[12-17] Epidemiological studies have described Q fever (*Coxiella burnetii*) infection on two UK farms.[18,19] One study of Johne's disease exists, investigating whether *Mycobacterium avium* paratuberculosis bacterium was present in raw milk from bulk tanks.[20] An outbreak of tuberculosis (TB) in a herd of Golden Guernsey goats has been described.[21] Two postal surveys confirmed ectoparasites to be a particular issue in goats, including those commercially farmed.[22, 23]

An evidence base from other countries is growing, but these are not specific for UK farms. Current practices and concerns within the industry must be better understood if further research is to have optimal value. Therefore, a postal survey was designed as a first step in addressing gaps in knowledge within the UK dairy goat industry to direct future research efforts.

Materials and methods

A postal survey was designed, covering husbandry practices and farmer observations of different age groups of goats, as well as farmer preferences for further research. Questions were informed by published peer reviewed literature on goats, non-peer reviewed secondary literature such as Goat Veterinary Society journals, goat veterinary texts and researcher experience of dairy goat farming. Kids were defined as goats from birth to weaning, youngstock as from weaning to first service and adult milking goats as those within the main milking herd, including dry does. Billies were defined as adult male goats. In total there were 55 questions with subparts, comprising both open and closed questions.

To promote return rate, the survey was designed to be completed within 15 minutes from memory with no requirement to locate exact figures. This was emphasized in a covering letter, which also explained that results would be treated confidentially. Farmers could complete the questionnaire anonymously or choose to provide contact details to receive an anonymised summary of the results.

This research was approved by the University of Bristol Research Ethics Committee.

A draft survey was pilot tested with 10 dairy goat farmers. Following feedback, the percentage categories used in the section concerning observations of goats were altered and a ranking activity was provided in the research priorities section instead of a completely open question. For the ranking activity 13 issues were presented in a table and farmers were asked to circle and rank the five issues that concerned them the most. This was supplemented by an open question on whether there were additional issues they would have liked the opportunity to include in their top 5.

In November 2017, the survey was posted to all full members of the Milking Goat Association, 70 in total with 67 members located in England and Wales, one in Scotland and one in Northern Ireland. A reminder letter was sent 3 weeks after the initial survey and then again 3 weeks later.

Data Handling and Statistics

Data were entered on to a spreadsheet (Excel;Microsoft) and analysed using IBM SPSS, version 24.0. (Armonk, NY: IBM Corp). Results are reported as simple summary statistics. Where percentages are given, the actual numbers are presented in the brackets when necessary, to avoid ambiguity. Individual Mann-Whitney tests were used to test if a difference in herd size was associated with Yes or No answers to a range of questions regarding approaches to husbandry.

Results

Seventy-three per cent (51 out of 70) Milking Goat Association members responded. Surveys from 46 individual farms were completed. The other 5 respondents informed the researcher they either worked with a farm that already completed a survey or they no longer kept goats.

Seventy per cent of farms answered all 55 questions, 17.4% farms answered 54 questions and 13% farms answered 53 questions.

The 46 farms that responded represented approximately 38% of the commercial dairy goat farms in England and Wales and held at least 24,372 goats, representing at least 53% of the commercial dairy goat population at the time of the survey (one farm did not answer the question about herd size).

Farm background information

Herd sizes, defined as number of adult milking goats including dry does, ranged from 6 to 2,300 goats with a median value of 400 goats (IQR 150 to 725).

The 46 farms that completed the survey comprised 18% of all farms in England and Wales with herd size 50 or fewer goats, 27.6% of all farms with herd size 51 to 200 goats, 52.9% of all farms with herd size 201 and 500 goats, 61.9% of all farms herd size 501 to 1000 goats and 33.3% of all farms with herd size over 1000 goats.

The periods of time producers had been farming dairy goats ranged from 1 to 42 years, median 11 (IQR 3 to 29). Reported milk yields ranged from 700 to 1,800 litres/goat/year, median 1022 (IQR 900 to 1184). One hundred per cent (46) farms reared their own replacement goats. Thirty-one per cent (14/45) farms ran a completely closed herd for both male and female animals. Sixty-seven point four per cent (31/46) farms practised out of season breeding. Seventeen per cent (8/46) farms

grazed goats outdoors. Eighty-seven per cent (40/46) farms had Saanen and Saanen crosses as their main breed. Toggenburg/Toggenburg crosses were present on 54.3% (25/46) farms, Alpine/Alpine crosses were present on 26.1% (12/46) farms, Anglo Nubian/AN crosses were present on 19.6% (9/46) farms and Golden Guerneys on 2.2% (1/46) farms.

Responses to questions about husbandry in kids are given in Table 1. Responses to questions about husbandry in adult milking goats are given in Table 2. Responses to the survey question 'has your herd ever been affected by the following diseases?' are given in Table 3. Vaccines used by farmers are given in Table 4. Factors associated with different herd sizes are given in Table 5. Farmers observations of kids and milking goats over the previous 12 months are given in Table 6. Farmer observations of adult male goats over the previous 12 months are given in Table 7. Farmer priorities for future research are given in Table 8.

Questions where farmers gave more than one response were those concerning: the types of colostrum fed, methods of feeding colostrum, methods of feeding milk to kids, types of forage offered to kids, types of market for male kids and routine hygiene practices undertaken in milking goats.

Table 1 Husbandry practices in kids		
Survey question	Response	% (number) of farms
For how long do kids remain with their mothers?	Removed at birth	21.7% (10/46)
	< 12 hours	8.7% (4/46)
	Between 12 and 24 hours	21.7% (10/46)
	Between 25 and 48 hours	21.7% (10/46)
	> 48 hours	26.1% (12/46)
Are kids fed colostrum other than by suckling their mothers?	Yes, sometimes	42.2% (19/45)
	Yes, routinely	40% (18/45)
	No	17.8% (8/45)
If yes, what type of colostrum is fed?	Colostrum from another doe	89.2% (33/37)
	Colostrum from another source	18.9% (7/37)
How is this colostrum fed?	Bottle fed	75.7% (28/37)
	By stomach tube	43.2% (16/37)
For how long are kids fed this colostrum?	< 1 day	21.6% (8/37)
	Between 1 and 2 days	64.9% (24/37)
	> 2 days	13.5% (5/37)
Is this colostrum pasteurised before feeding?	Yes	10.8% (4/37)
	No	89.2% (33/37)
Is colostrum quality measured?	Yes	10.8% (4/37)
Are kids fed milk replacer?	Yes	87% (40/46)
	No	13% (6/46)
At what age are kids first fed milk replacer?	1 to 2 days	60.5% (23/38)

	3 to 4 days	26.3% (10/38)
	5 to 7 days	10.5% (4/38)
	14 to 21 days	2.6% (1/38)
How are kids fed milk?	Ad lib (always available)	85% (36/40)
	Restricted (in meals)	15% (6/40)
Are kids fed starter/creep feed?	Yes	95.7% (44/46)
	No	4.3% (2/46)
At what age are kids first fed starter/creep?	Less than 7 days	47.5% (19/42)
	7 to 14 days	37.5% (15/42)
	14 to 21 days	2.5% (1/42)
	Over 21 days	17.5% (7/42)
Are kids fed forage?	Yes	95.7% (44/46)
	No	4.3% (2/46)
What type of forage is fed to kids?	Hay	50% (21/42)
	Straw	59.5% (25/42)
	Haylage	9.5% (4/42)
	Silage	4.8% (2/42)
At what age are kids first fed forage?	Less than 7 days	47.6% (20/42)
	7 to 14 days	42.9% (18/42)
	over 21 days	9.5% (4/42)
Do you have a target weaning age?	Yes	75.6% (34/45)
	No	24.4% (11/45)
Do you have a target weaning weight?	Yes	41.3% (19/46)
	No	58.7% (27/46)
What is your target weaning age?	Under 6 weeks ^(min 5 weeks)	3.4% (1/29)
	6 to 8 weeks	69% (20/29)
	12 to 16 weeks	17.2% (5/29)
	Over 18 weeks ^(max 32 weeks)	10.3% (3/29)
What is your target weaning weight?	Under 15kg ^(min 12kg)	10.5% (2/19)
	15kg	57.9% (11/19)
	Over 15kg ^(max 20kg)	31.6% (6/19)
Do you have a market for your male kids?	Yes	76% (35/46)
	No	24% (11/46)
What is your market for males?	Breeding	28% (13/46)
	Meat	74% (34/46)
Do you rear any kids for meat on your own farm?	Yes	54% (25/46)
	No	46% (21/46)
Are kids disbudded?	Yes	100% (46/46)
What age are kids disbudded?	Less than 14 days age	93.3% (42/45)
	Between 14 and 28 days age	0% (0/45)
	28 days or older	6.7% (3/45)
Does your local vet have sufficient knowledge and experience of dairy goats?	Yes	82.6% (38/46)
	No	6.5% (3/46)
	Not sure	10.9% (5/46)

Table 2 Husbandry practices in adult milking goats		
Survey question	Response	% (number) farms
Are milking goats fed forage?	Yes	100% (46/46)
What type of forage is fed?	Hay	51.1% (23/45)
	Haylage	40% (18/45)
	Silage	26.7% (12/45)
	Straw	24.4% (11/45)
Is forage analysed?	Yes	50% (23/46)
	No	50% (23/46)
Are milking does fed concentrate?	Yes	98% (45/46)
How are concentrates fed?	Ad lib	37.8% (17/45)
	Set ration per goat	37.8% (17/45)
	Mixed with forage	24.4% (11/45)
Are goats fed according to yield?	Yes	35% (16/46)
	No	65% (30/46)
Are goats fed in the parlour?	Yes	50% (23/46)
How are these goats fed in parlour?	Small amount for encouragement	50% (11/22)
	Individual ration	50% (11/22)
Do you aim to give goats a dry period?	Yes	100% (46/46)
For how long is this dry period?	< 2 weeks	5.3% (2/38)
	3 – 4 weeks	17.4% (8/46)
	5 – 7 weeks	43.5% (20/46)
	7 weeks or more	34.8% (16/46)
How often are goats milked at peak yield?	Twice daily	93.3% (42/45)
	Three times daily	6.7% (3/45)
Which of the following are done routinely at milking?	Gloves worn	54.3% (25/46)
	Foremilk checked	37% (17/46)
	Teat wiped	56.5% (26/46)
	Teat dip pre-milking	6.5% (3/46)
	Teat dip post milking	34.8% (16/46)
	No routine practices used	17.4% (8/46)
Do you record milk yields?	Yes	52% (24/46)
	No	48% (22/46)
If yes, how do you record milk yields?	Electronic/automatic recording	45.5% (10/22)
	Manual	54.5% (12/22)

If yes, are yields recorded for individual goats or for groups of goats?	Yields for individual goats	90.9% (20/22)
	Yields for groups of goats	9.1% (2/22)
What is your target kidding interval?	12 months/annual	38.5% (15/39)
	Between 12 and 24 months	46.2% (18/39)
	Between 24 and 36 months	7.7% (3/39)
	Flexible according to yield	7.7% (3/39)
Do you have a target age for first service?	Yes	98% (45/46)
	No	2% (1/46)
What is your target age at first service?	6 to 7 months	40.9% (18/44)
	8 to 9 months	20.5% (9/44)
	10 to 12 months	20.4% (9/44)
	13 months or more	18.2% (8/44)
Do you have a target weight for first service?	Yes	67.4% (31/46)
	No	32.6% (15/46)
If yes, what is your target weight at first service?	Less than 35kg	11.1% (3/27)
	From 35 to 40 kg	70.4% (19/27)
	More than 40kg	18.5% (5/27)
Are goats routinely foot trimmed?	Yes	100% (46/46)
What age are goats first foot trimmed?	< 3 months	8.7% (4/46)
	3 to 5 months age	15.2% (7/46)
	6 to 8 months age	32.6% (15/46)
	9 to 12 months age	28.3% (13/46)
	Over 12 months age	6.5% (3/46)
	As necessary	8.7% (4/46)
How often are the feet trimmed?	Every 1 to 2 months	15.6% (7/45)
	Every 3 to 4 months	35.6% (16/45)
	Every 5 to 6 months	33.3% (15/45)
	Every 7 to 12 months	6.7% (3/45)
	When needed/as often as possible	8.9% (4/45)
Are goats routinely footbathed?	Yes	20% (9/45)
	No	80% (36/45)

Disease	Yes	No	Don't know	Never heard of it
Johne's disease	48.9% (22/45)	42.2% (19/45)	8.9% (4/45)	0
Caseous lymphadenitis (CLA)	6.7% (10/45)	71.1% (32/45)	6.7% (3/45)	0
Tuberculosis (TB)	6.7% (3/45)	93.3% (42/45)	0	0

Caprine arthritis encephalitis (CAE)	11.1% (5/45)	78.3% (33/45)	15.6% (7/45)	0
Scrapie	8.7% (4/46)	91.3% (42/46)	0	0

Name of vaccine(s) used	Number (%) farms (n/46)	Diseases the vaccine is intended to prevent
Guidair® (CZ vaccines)	56.5% (26)	Johne's disease
Lambivac® (MSD Animal Health)	82.6% (38)	Clostridial enterotoxaemia
Covexin® (Zoetis)	2.2% (1)	Clostridial enterotoxaemia
Bravoxin® (MSD Animal Health)	2.2% (1)	Clostridial enterotoxaemia
Enzovac® (MSD Animal Health)	19.6% (9)	Enzootic abortion
Cevac Chlamydia® (Ceva Animal Health Ltd)	6.5% (3)	Enzootic abortion
Toxovac® (MSD Animal Health Ltd)	26% (12)	Toxoplasmosis
Coxevac® (Ceva Animal Health Ltd)	8.7% (4)	Q – fever
Ovipast® (MSD Animal Health)	13% (6)	Pasteurellosis
Heptavac P Plus® (MSD Animal Health)	17.4% (8/46)	Clostridial enterotoxaemia, pasteurellosis
Glanvac® (Zoetis)	4.3% (2/46)	Caseous lymphadenitis
Glanvac 3® (Zoetis)	2.2% (1/46)	Caseous lymphadenitis, clostridial enterotoxaemia

Based on vaccines used, 57% (26/46) farms vaccinated for Johnes disease, 98% (45/46) farms vaccinate for clostridial enterotoxamia, 28.3% (13/46) farms vaccinate for infections that commonly cause abortion, 23.9% (11/46) farms vaccinate for pasteurella infection and farms 6.5% (3/46) vaccinate for caseous lymphadenitis.

Factors	Median herd size of farmers responding 'yes'	Median herd size of farmers responding 'no'	Mann-Whitney U	p
Out of season breeding used	600	196	311.5	.001
Goats grazing outdoors	34	600	17	.001

Kids fed milk replacer	560	50	206	.002
Forage analysed	700	200	412	<.001
Feeding total mixed ration (TMR)	870	250	319.5	<.001
Automatic/electronic recording of milk yields	815	150	119.5	.002
Fed individual ration in parlour	60	600	27	.016

Table 6 Farmers observations of their goats over the previous 12 months					
Age group	Signs observed	Proportion of affected goats within farm			
		<2%	>2% <5%	5 – 15%	>15%
Kids	Poor growth	68% (30/44) farms	13.6% (6/44) farms	15.9% (7/44) Farms	2.3% (1/44) farms
	Deaths	47.8% (22/46)	26.1% (12/46)	17.4% (8/46)	8.7% (4/46)
	Skin problems or itch	85.7% (36/42)	9.5% (4/42)	4.8% (2/42)	0
	Scour/diarrhoea	39.5% (17/43)	20.9% (9/43)	32.6% (14/43)	7% (3/43)
	Pneumonia/excess cough	36.4% (16/44)	38.6% (17/44)	15.9% (7/44)	9% (4/44)
	Swollen joints or swollen navel	88.1% (37/42)	9.5% (4/42)	2.4% (1/42)	0
	Youngstock	Poor growth	62.8% (27/43)	23.3% (10/43)	11.6% (5/43)
Deaths		72.7% (32/44)	18.2% (8/44)	6.8% (3/44)	2.3% (1/44)
Skin problems/itch		54.8% (23/42)	4.9% (2/42)	7.3% (3/42)	0
Scour/diarrhoea		62.8% (27/43)	23.2% (10/43)	14% (6/43)	0
Pneumonia/excess cough		57.1% (24/42)	26.2% (11/42)	16.7% (7/42)	0
Difficult to get in kid		54.8% (23/42)	23.8% (10/42)	16.7% (7/42)	4.8% (2/42)
Adult milking	Overly thin	65.9% (27/41)	24.4% (10/41)	4.9% (2/41)	4.9% (2/41)
	Overly fat	31% (13/42)	21.4% (9/42)	31% (13/42)	16.7% (7/42)
	Difficult to get in kid	41.9% (18/43)	25.6% (11/43)	25.6% (11/43)	7% (3/43)
	Difficult to dry off	39.5% (17/43)	27.9% (12/43)	23.3% (10/43)	9.3% (4/43)

goats	Assisted kidding	41.3% (19/46)	34.8% (16/46)	17.4% (8/46)	6.5% (3/46)
	Abortion or stillbirths	6.4% (28/44)	22.7% (10/44)	6.8% (3/44)	6.8% (3/44)
	Cloudburst	55.8% (24/43)	14% (6/43)	23.3% (10/43)	7% (3/43)
	Lame	61.4% (27/44)	15.9% (7/44)	13.6% (6/44)	9.1% (4/44)
	Mastitis	63.6% (28/44)	34.1% (15/44)	2.3% (1/44)	0
	Scour/diarrhoea	41.9% (18/43)	27.9% (12/43)	27.9% (12/43)	2.3% (1/43)
	Pneumonia/excess cough	71.4% (30/42)	28.6% (12/42)	0	0
	Skin problems/itch	70.5% (31/44)	13.6% (6/44)	15.9% (7/44)	0

Table 7 Farmer observations of their billies (adult male goats) over the previous 12 months (n/46)

Signs	Number (%) of farms
Overly fat	6.5% (3)
Overly thin	13% (6)
Lameness	26.1% (12)
Scour/diarrhoea	26.1% (12)
Skin problems/itch	17.4% (8)

For each age group of goats, farmers were asked if they had seen any other signs, over the previous 12 months. The number of farmers responding 'yes' were 21.7% (10/46) for kids, 6.5% (3/46) for youngstock, 17.4% (8/46) for adult milking goats and 10.9% (5/46) for billies.

Additional signs reported for kids were bloat, sore heads due to infections following disbudding, weak hind legs, coccidiosis, cryptosporidia, persistent diarrhoea, navel hernias, sudden death at 9 days age, scours and meningitis. Additional signs for youngstock were listeria, coccidiosis and orf. Those for adult milking goats were CLA, ketosis, listeria, twin lamb disease, laminitis, Yersinia, chlamydia and teat biting and those for billies were CLA, excessive horn growth, listeria, blocked urethra, mastitis and pneumonia.

Table 8 Farmer priorities for future research

Issue	% (number) farms ranking this issue in their top 5 concerns (n/44)
Kid health (pneumonia and/or scour)	79.5% (35)
Johne's disease	65.9% (29)
Tuberculosis (TB)	59% (26)
Nutrition/feed management	47.7% (21)
Lameness	27.3% (12)
Abortion/stillbirth	25% (11)

Mastitis	22.7% (10)
Fertility	18.2% (8)
Colostrum	18.2% (8)
CLA	13.6% (6)
CAE	11.4% (5)
Growth rates	11.4% (5)
Skin problems	6.8% (3)

Discussion

A substantial proportion of the UK commercial dairy goat population was represented by this survey, although findings are skewed towards larger farms, probably because these are more likely to be Milking Goat Association members.

Farm background

Reported average milk yields (median 1022 litres/goat/year, IQR 900 to 1184) were higher than those previously reported for UK farms (median 825 litres/goat/year, IQR 640 to 904),[2] perhaps reflecting changes in breeding and husbandry that better support production. There was no relationship between herd size and milk yield.

Only 17% of farmers grazed goats outdoors, probably because managing such large numbers of goats outdoors is impractical, partly due to difficulties in managing nutrition of high yielding goats at pasture and partly because goats remain susceptible to infections with gastrointestinal parasites.

Sixty-seven per cent of farmers manipulated the breeding season, which would enable them to produce a more even volume of milk throughout the year and to take advantage of the higher milk prices paid in the autumn and winter months.

Thirty-one per cent of farmers operate a completely closed herd which optimises their biosecurity. Further investigation is needed to establish how these farms maintain genetic diversity and how the questions were interpreted, for example, whether farmers considered a closed herd to be one that allowed some males onto the unit every few years.

Kids

Whatever feeding strategy is used, kids must ingest sufficient quantities of good quality colostrum within the first hours of life in order to absorb enough immunoglobulins to protect them from disease.[24] On most farms, kids remained with their mothers for at least the first hours of life, enabling them to suckle colostrum naturally. However, there is little information about the quality of colostrum produced by does on UK farms as studies to date have involved different breeds and

management system in different countries, with none from the UK. Refractometers, used by two farms to measure colostrum quality, have not been validated for use in goats. The colostrometer, used by one farm, has been found moderately accurate.[25]

There are benefits in feeding kids colostrum beyond the initial 6 hours when they best acquire immunity because it provides local immune protection in the gut, has superior nutrition to milk and contains many other beneficial substances such as growth hormones. Colostrum gradually transitions to milk over 3 to 5 days.[26] However, just under half the farms kept kids with their mothers for over 24 hours and some farms for upto 48 hours, meaning much colostrum and transition milk is wasted as once kids are separated from their mothers it is practically difficult to isolate and feed this milk.

Possible reasons for removing kids from their mothers at or shortly after birth include limiting contact with the adult environment to reduce disease risks, preventing the doe and kid bonding to reduce the stress of separation and kids potentially more readily learn to suck an artificial teat than if removed later. Possible reasons for leaving longer include saving labour and ensuring full use of colostrum. Of the 10 farms that left kids with their mothers for over 48 hours, 8 farms specified the duration. For 7 farms this was between 3 and 7 days whereas one farm of herd size 500 had a unique system of leaving kids with their mothers for 5 weeks.

Some farms routinely provided doe colostrum in addition to that which the kid suckled, either via a stomach tube or bottle. It would be useful to know the source of this doe colostrum as feeding colostrum from another doe, or pooled from several does, can accelerate the spread of diseases that pass from infected adults to kids via the milk, for example caprine arthritis encephalitis and scrapie.

Four farms fed colostrum replacer routinely as their only source of colostrum. For these farms, the type of replacer used will be particularly important. For example, lyophilised or freeze-dried bovine colostrum can be adequately absorbed by goat kids [27,28] whereas replacer derived from ewe colostrum has been found inadequate.[29]

Details of volumes of colostrum fed and whether these align with recommendations in goat texts, of 10% of bodyweight in the first 12 hours or 20% of bodyweight in the first 24 hours of life, are needed.[30]

Most farmers follow colostrum feeding with milk replacer as this is considered more economical and practical than feeding goat's milk, despite the higher digestibility, faster growth rates [29] and better immune function of kids when fed goat's milk.[31]

Most farms indicated that they fed milk replacer ad lib, which produces higher growth rates than restricted feeding due to the larger volumes of milk ingested[29]. However, intake may not be truly ad lib for all goat kids in the group as they share access to teats with varying numbers of pen mates and, unlike calves, the individual milk intakes cannot be monitored or rationed. The intake of some kids could well be reduced by competition from pen mates.

Optimal milk intakes for kids in the first weeks of life are unknown. Few studies look beyond the first weeks of life and the effect milk feeding will have on solid food intake and any growth check and hunger at weaning.[32]

The digestibility of different milk replacers should also be investigated further.

M.J. POTCHOIBA

Goat kids, as with all young ruminants, must ingest solid feed to develop a functioning rumen. Most farms offered kids both forage and starter feed before they were two weeks age, which gives kids opportunity to become familiar with this feed before they begin to ingest substantial quantities.

As in calves, fermentation of starter feeds are likely to provide butyrate needed to develop rumen papillae and forage is likely to promote muscular development of the rumen, and stimulate rumination and flow of saliva into the rumen.[33] However, the optimal balance between forage and starter and types used needs further investigation.

Weaning age and weaning weight are proxy measures of rumen development. The target weaning weights of most farms are in line with the recommended weaning weights for goats [34] of 2.5 times their birthweight, though little research underpins these values. Further details, such as numbers of farms that weigh their goats at weaning and whether milk feeding is stopped abruptly or gradually at weaning [31] are needed.

Female goat kids are routinely disbudded on all farms, as dehorned goats can be housed at higher stocking densities than horned goats and are thought less likely to become trapped in pen structures .[35] Most farms met the recommendations of disbudding within the first week of life.

UK law specifies that disbudding of goat kids must only be performed by a veterinary surgeon (Veterinary Surgeons Act 1966, Schedule 3, Part 2). Farmers comments about veterinary input were mostly positive, implying that many farms can find a vet able to disbud their goat kids to a satisfactory standard. However, 20% of farmers still experienced some difficulties with accessing veterinary input to a standard that met their needs. Disbudding kids is more technical than disbudding calves due to the double innervation of the horn bud in the kid making anaesthesia more difficult and the thin skull of the kid risking thermal injury to the brain.[36] Disbudding goats is often not a routine part of veterinary training.

Markets for goat meats have rapidly expanded in recent years, reducing the number of male billy kids that are killed at birth with 75% farms having a market for their male kids. Further investigation is needed into the proportion of male kids these farms have a use for. To date, very little is known about the health, welfare and production on dedicated kid rearing units.

Adult milking goats

In the survey, the term forage was intended to mean those feeds that are predominantly cellulolytic and slowly fermented in the rumen and concentrate those feeds that are predominantly amylolytic and rapidly fermented.

All farms fed their milking goats forage and for the 50% [25] farms that analyse forage there is potential to use this information to better match the feed to the animals' nutrient requirements. All farms fed concentrates, which is expected as forage alone would not meet the energy requirements of high yielding does.

The 24% (11/45) farms that offer goats concentrate mixed with forage do so as a total mixed ration (TMR). It is unsurprising that farms with larger herd sizes tended to feed TMR as they are more likely to have the necessary resources and space.

Of the 23 farms that feed goats in the parlour, 11 of these fed an individual ration of concentrate in the parlour, ensuring their intake is known as they can consume this without competition. These were smaller farms, who could probably milk at a slower rate. On many farms goats only stay in the parlour for the duration of milking, often only 1 to 2 minutes, which is insufficient time for them to eat their individual concentrate ration.

The remaining farms offered goats concentrate whilst housed in their pens, either ad lib or calculated as a set amount per goat. However, this may not have been the amount each goat has access to or consumes when in a group situation.

Those 52% of farms that record milk yields have the potential to use these records to select individuals for breeding or to guide feeding strategies. Thirty-five per cent of farms reported they fed to yield. More information is needed about how farmers interpreted this term and how they are implementing the practice, for example, whether they feed individual goats based on their individual yields, manage groups with a stepped approach or do otherwise.

Milking

Routine hygiene practices, such as teat wiping and teat dipping, were minimal. Seventeen per cent of farms do not use any sort of udder and teat preparation. Potential reasons include goats being much cleaner than cattle,[3] goats perceived less susceptible to mastitis and time pressures, with the stockperson attending to a different goat every few seconds. Fore-milking is often omitted, in part because visual inspection of milk and measuring somatic cell counts using a California mastitis test are less reliable indicators of udder infection than in cattle.[37,38] In addition, between 60 to 80% of udder milk is cisternal in goats, requiring little udder preparation to stimulate milk let down. However, many of the routine hygiene practices used in cattle are still considered to benefit udder health in goats.[38]

There is currently little evidence on optimal dry period lengths, with very few studies investigating how it affects colostrum quality [38, 39] or milk yield in subsequent lactations. [40, 41]

Goats have potential to milk for extended periods of time, often years, without giving birth, therefore, potentially reducing the frequency of kidding and associated health risks. However, there have been few studies of the management needed for extended lactations to be successfully used.[42, 43]

All farmers were aware of the main infectious diseases of dairy goats. However, where farmers answered 'no' to presence of disease, they may have been unaware that their goats can be infected without showing obvious clinical signs. Also, this survey did not establish whether disease presence or absence was confirmed by veterinary diagnostic tests.

Almost half of farms reported they had been affected by Johne's disease (infection with MAP). Vaccination will control, but not prevent, infection in goats. To date, there are no prevalence studies of Johne's disease on UK goat farms, despite its economic and public health significance.

Commercially farmed goats are at particular risk of clostridial enterotoxaemia [44] a fatal disease caused by the usually commensal *Clostridial perfringens* type D bacteria. Hence, it is positive that 98% farms vaccinate to reduce risks. All clostridial vaccines used are multivalent. Goat owners are advised to use vaccines with the lowest number of pathogen strains, as these will provide the best possible immune response to the main clostridial disease of dairy goats, clostridial enterotoxaemia disease caused by *Clostridial perfringens*. [44] Therefore, it is positive that 82.6% of farmers use Lambivac®.

Overall, few vaccines have been developed for, properly evaluated in or licensed for use in goats.

Farmer observations

The farmer observations of clinical signs in their goats provide useful information but have their limitations and biases. For example, interpretation of and detection of the various signs will vary between farmers. Also, farmers may have been unlikely to circle the upper value, whatever the figures presented, unless they felt a certain sign a particularly large problem on their farm. Although some signs would have been better served by different percentage values, presenting too many different numbers could have made completion more difficult, producing fewer responses.

When trialling the questionnaire, farmers advised that 'under 2%' was a more useful figure than zero, as virtually no farms are free of the signs listed. Also, they naturally tended to choose the category with the lowest appropriate incidence, so 'less than 2%' being within the 'less than 5%' bracket was not a problem in practice.

Scours (diarrhoea), followed by pneumonia, poor growth and deaths, were the most prominent signs observed by farmers in their kids, in line with findings from the small number of studies of dairy goat kids intensively reared in other countries [45-47] and with studies of dairy calves. [48]

Farmers still observed considerable pneumonia and diarrhoea in their youngstock though to a lesser extent than in the kids. Failure to conceive was also prominent and is likely to be costly, as in heifers [49]. Possible underlying causes, such as failure to meet recommended weaning weights at target weaning ages need further investigation. Larger herds had lower target weights for first service, probably due to more intensive management, emphasizing reaching this stage more quickly.

Overly fat milking goats (body condition score >3) [34] produce less efficiently and are predisposed to metabolic problems, dystocia and infertility than goats in the correct condition for their stage of production. Body condition scores developed for goats [50] require the sternal area to be palpated, as sternal fat reserves are a better indicator of total body fat than the lumbar reserves are. However, little is known about their use in the field and how farmers currently gauge body condition of their goats.

Cloudburst, or hydrometra, is prominent on some farms, lowering conception rates, but little studied.

Anecdotally goats are more difficult to dry off during the summer months, which is thought could lead to a shortened dry period.

Few farms reported lameness prevalence greater than 5%, which contrasts with previous research findings [3] where overall lameness prevalence of goats on 24 farms was 19.2%, ranging from 7.7% to 52.5% of goats per farm. However, farmer reports could well be underestimates.[5] Detection can be difficult where large numbers of goats are housed at a high stocking density on straw bedding.[3] Lameness is more easily detected when goats exit the parlour, but they are less likely to be observed at this time. Also, mild to moderate lameness can become normalised.

Signs of diarrhoea are more prominent in adult milking goats than in youngstock, which could be due to sub optimal feed management and sudden diet changes in adults.

Few farmers report mastitis incidence to be over 5%, which is in line with other studies of mastitis in goats.[38,51] However, further research is needed. Subclinical mastitis may affect production more than previously thought [51] and the prevalence of this on 3 UK dairy goat herds was reported as 26%, 39% and 24%.[7] Also, udder abnormalities, defined as asymmetry of udder halves, irregular swelling and skin lesions, were prominent on UK farms.[3]

Farmers priorities for future research

Whilst many farmers selected and ranked five issues as requested, there were also farmers that chose fewer issues or chose five issues without ranking. However, the proportion of farms ranking certain issues in their top five, in association with the open question, were used to gauge farmers main concerns.

Although 76.1% of farmers ranked kid diseases, pneumonia and scour highly, only 18.2% considered colostrum management a priority, despite the importance of colostrum for kid health in the early weeks of life. Farmers may feel that colostrum management was automatically a part of kid health and omitted it for this reason. Alternatively, farmers may be less aware of the role of colostrum in disease protection in kids or may assume they have already optimised their colostrum feeding practices, ruling this out as an underlying cause.

Johne's disease was reported as a major concern. This is unsurprising as there has been growing awareness of this disease amongst farmers and milk buyers, with potential for a damaging public health scare due to purported links between Crohns's disease in humans and ingestion of MAP bacterium by humans when they consume dairy products.

Tuberculosis (TB) remains a high priority, probably due to public health concerns and the economic consequences of TB diagnosis on farm. To date, in the UK confirmed cases of TB in goats have been caused by *Mycobacterium bovis*, the same bacterium that causes bovine TB.

At the time of the survey little compensation was paid for goats slaughtered due to suspected infection. Most farmers will not know their TB status as routine surveillance testing is not mandatory in goats.

It is unsurprising that nutrition was high priority, as feed cost is a substantial component of farm costs on dairy farms and farmers are generally aware of its importance to health and production.

Only 21.6% (12/46) farms considered lameness to be a top priority which could reflect difficulties with lameness detection as already described. Abortion and stillbirths were also ranked relatively low, perhaps because farmers saw milk produced as being the main product and not live kids.

No farms added claw overgrowth to the list, despite a previous survey of 24 farms identifying this as a major issue.[3]

Where farmers added issues to their list of main concerns, they tended to extrapolate on or emphasize aspects of an area they had already ranked. New issues raised were worming strategies, listeria and disbudding.

Conclusion

This survey provides a better understanding of current practices and concerns on dairy goat farms within this UK cohort, enabling further research to have optimal value by staying relevant and focussing on areas where most impact can be made. Such research is urgently needed as currently there is little evidence base available to support farmers in achieving good health, welfare and production on UK dairy goat farms.

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