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Managing dairy ewes to produce a better outcome for cheese production

Final project report

June 2022

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Project Aim

The aim of the project was to evaluate milk quality and composition of a group of milking ewes producing milk for unpasteurised cheese production. The farm is located on the Lleyn peninsula in north Wales and have been milking sheep since 2018.

Background (including delays and changes to original plan)

The project started in 2019 and was meant to follow the farm production cycle for two consecutive years. Due to the global pandemic and the difficulty of visiting the farm and sample collection and submission the project was stopped after year one and restarted a year later in 2021.

In 2019 the farm was milking 45 ewes of which 15 were Friesland ewes on their second lactation bought from a milking flock in Dorset. The rest were Lleyn ewes, native to the Lleyn peninsula, 15 of them were local and lambed in March 2019 and 15 others were adult ewes, bought later in the season from a farm in Yorkshire where they lambed late May. The farm and cheese maker are aiming for a pure Lleyn milking flock as this breed is well adapted to the conditions in the region and they would be able to produce a true native Welsh product as both a source of pride and a unique selling point.

By 2021, the farm was milking up to 135 ewes. The added ewes were all Lleyn ewes, both older ewes used previously for commercial lamb rearing on the farm, and replacement “gimmer” ewes reared on farm. On both project years, the ewes were brought from different sources and at different stages of their productive lives, so it was not possible to accurately compare between ewes or breeds but to make some observations only.

For the purpose of the project, the same ewes sampled in year 1 were sampled again in year 2, until the final sampling session in October 2021. More ewes were sampled in 2021, all were ewes introduced to the farm after year one of the project. The ewes were milked twice a day for the first couple of weeks (according to milk processor’s needs) and then moved to a once-a-day milking system. All ewes had their lambs running with them until they were weaned at 6 to 8 weeks. The flock was grazing throughout the lactation period and were also supplemented with bale haylage and concentrate feed in the parlour. Concentrate feed was replaced with Whole Barley for cost reasons halfway through the season and fed at a rate of 200gr/head/ day. High energy lick buckets were available for the ewes for a short period after lambing.

In year 2 of the project, individual milk samples were taken from 53 ewes on the 07/04/2021, 55 ewes (with one insufficient sample and six missing) on the 27/04/2021, 85 ewes (with one insufficient sample and eight missing samples) on the 19/05/2021, 55 ewes (one missing sample) on 15/06/2021, 60 ewes (one insufficient and four missing samples) on 01/07/2021, 56 ewes (six missing samples) on 20/07/2021, 56 ewes (one insufficient and five missing samples) on 10/08/2021, 64 ewes (fourteen missing samples) on 01/09/2021, 64 ewes (fourteen missing samples) on 21/09/2021 and 35 ewes (with one insufficient sample) on the 12/10/2021, where most of the ewes were ones not sampled before.

All individual ewe samples were tested for presence and type of bacteria in the milk, number of Somatic cell Counts (SCC) as a marker of udder inflammation and possible clinical or sub clinical mastitis, milk composition (Fat, Protein and Lactose percentages) and Aerobic Plate Counts of bacteria.

Due to missing samples and some samples sent without individual ewe's identification, it was not always possible to follow each ewe all the way through the 2021 milking season.

Bulk tank milk samples were also taken at each sampling session and were tested for Somatic Cell Counts (on all submissions but three), Aerobic Plate Count, *S.aureus* and *E.coli* counts, presence of *Salmonella* species, *Listeria.monocytogenes* and *E.coli* 0157 and general bacteriology.

As bulk milk samples from year 1 tested positive for the presence *Pseudomonas.fluorescens* in high levels, it was decided that in year 2, mains water samples (used in the milking parlour) will be submitted alongside the bulk milk samples to try and identify the source of the bacterial contamination.

As no correlation was found in year 1 between milk and nasal swabs samples, no nasal swab samples were submitted in year 2 of the project. Instead, ten milk sampling sessions were conducted during the year, to better monitor the milk quality of the flock throughout year 2's milking season.

Due to the pandemic, no external visitors were allowed on farm during year 2 of the project. The pandemic also caused disruption to some of the farm plans to adopt some year 1 recommendations such as installing milk meters and earlier culling of some ewes with chronically infected udders. The project team and external advisor were unable to meet face to face and discuss interim (and final) results and making constant improvements.

Some of the milk samples sent were late to arrive, potentially having a negative effect on the bacterial results. Much time was spent by the farm staff and cheese producer ensuring both the milking flock and cheese production remain viable under unforeseen, difficult circumstances.

As in year 1, all samples were taken by the farm staff and sent for analysis at Quality Milk Management Services Ltd (QMMS) laboratory, Easton, Wells. Sending samples to the laboratory for analysis had to be delayed at times which could have had a negative effect on some of the quality or number of bacteria identified in some of the samples sent. Bacterial organism identification, following aerobic culture on both selective and non – selective media, was undertaken using MALDI-ToF analysis. Milk quality and Somatic Cell Counts were analysed using a Delta CombiScope, model FTIR 400, Drachten, The Netherlands.

Analysis of Individual Milk Samples

See appendix 1 for list of individual milk sample results

All the ewes who had high SCC for 5 times or more are to be considered chronically infected. Of this group of ewes, one was a Lleyn ewes (1000) and all the others are Friesland ewes who were bought in 2018 to start the milking flock. Some of these ewes have already been identified as carrying a chronic infection in year 1 of the project and some were culled out since. Those ewes were infected with various *Staphylococci* species, mainly *S.Microti*, *S.Epidermidis*, *S. warneri* and *S.chromogenes*. *Pseudomonas fluoroscens* was also cultured from two of these ewes (16611 & 12078).

The same should also be suspected of the ewe identified as IWAN, as it had a high SCC in all her three samples. This ewe was repeatedly cultured with *Staphylococcus.aureus* who is also a known cause of contagious udder infection in cattle and sheep. *Staphylococci* are predominantly contagious bacteria and are present on mammalian skin. Wearing gloves in the parlour, good udder hygiene, hygienic milking routine and an appropriate post milking teat dip should help reduce the risk of infection within the flock.

Curing such chronic, recurrent infections is unlikely and these ewes should be considered for selection out of the milking flock as they would pose a risk of infection, via the milking machine during milking, to other ewes.

They would also contribute to the overall bacterial load of the bulk tank (as will be shedding large numbers of bacteria in the milk, continuously or intermittently) and the overall bulk tank SCC.

The ewes which only had a single high SCC were possibly experiencing a case of mastitis and some were cultured with Bacteria such as *Strep. dysgalactia* and *Manhymia.haemolytica* who are often identified as causing mastitis.

Overall, throughout the 2021 milking season, only one ewe, who was not sampled as part of the project, suffered severe mastitis and died as a result. No other ewes were identified and recorded as having mastitis, but clots were occasionally found in the milk filter, indicating mastitis like changes in the milk. Some of these ewes also had a high Aerobic Plate Count at the time of the high SCC, supporting the theory of them suffering a mild form of mastitis, which went undiagnosed and quickly self-cured.

Aerobic Bacterial Plate counts were high, above a 10,000 cfu/ml threshold (recommended by the British Sheep Dairy Association, BSDA and the Specialist Cheese Association, SCA), in 35 samples out of a total of 584 samples analysed during 2021 season. Ten of these sample were identified as contaminated by the laboratory so overall only 4.2% of the samples (25 samples out of the 584 taken) were high - indicating an overall good quality of milk, well withing BSDA and SCA recommendations.

Some of the high plate counts were associated with the ewes suffering from a chronic udder infection while others were samples taken from ewes with a single high SCC sample, or with a SCC below the 500,000 cells/ml threshold.

The bacteria Most commonly associated with the High Aerobic Plate Counts were *Pseudomonas fluorescens*- in 12 samples, *Staph. Epidermidis* and *Psychrobacter spp* - both in 5 samples each, and *Lactococcus lactis* (a non-pathogenic bacterium used in butterfat and cheese production) in 3 of the samples.

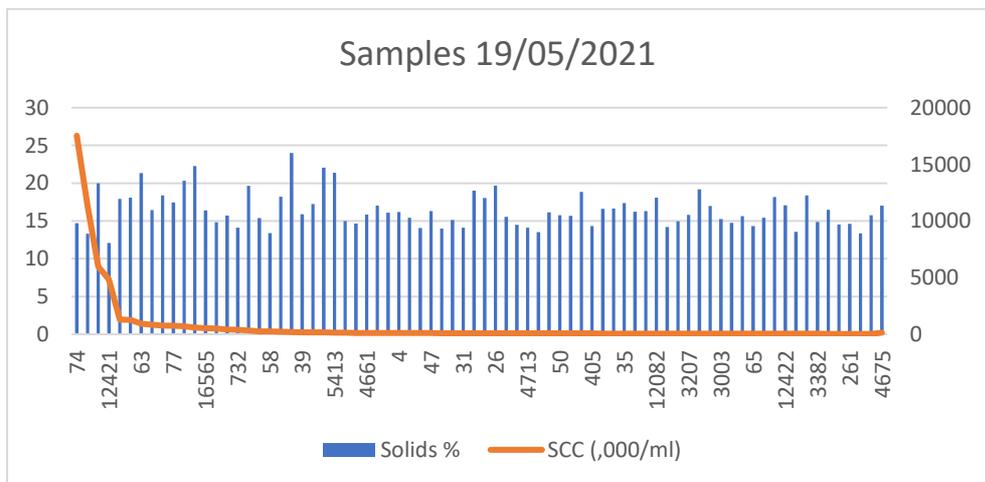
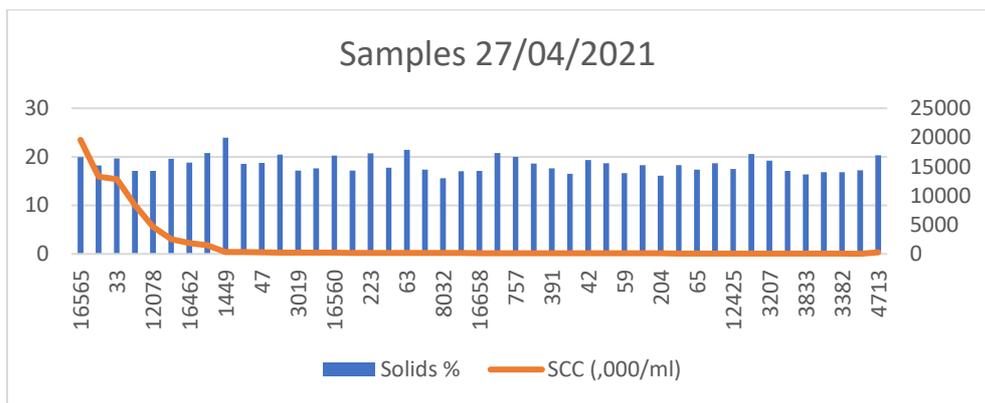
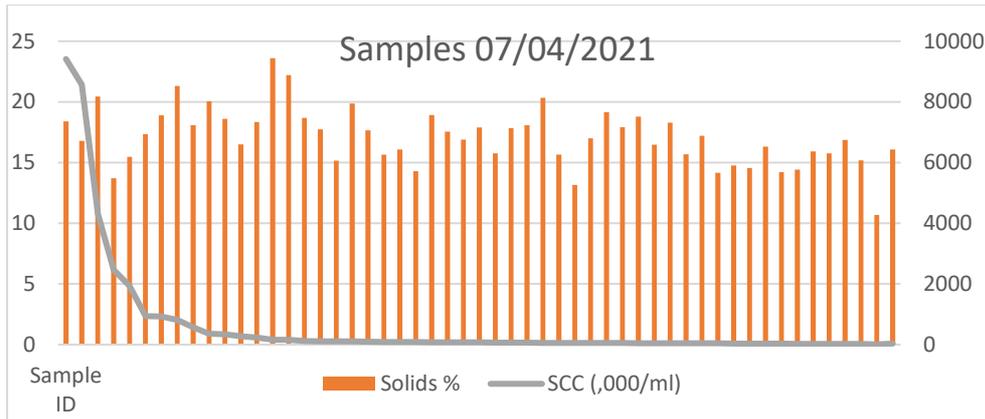
Eleven of the *Pseudomonas fluoroscens* samples were taken at the 19/05/2021 sampling session (overall 18 samples taken at that date were cultured with *Pseudomonas*, seven of which did not result in a high Aerobic Plate Count) indicating either a high flock infection rate or more likely, a contamination during the milking and sampling routine on the day. Very few other samples cultured *Pseudomonas* bacteria on any of the other sampling dates.

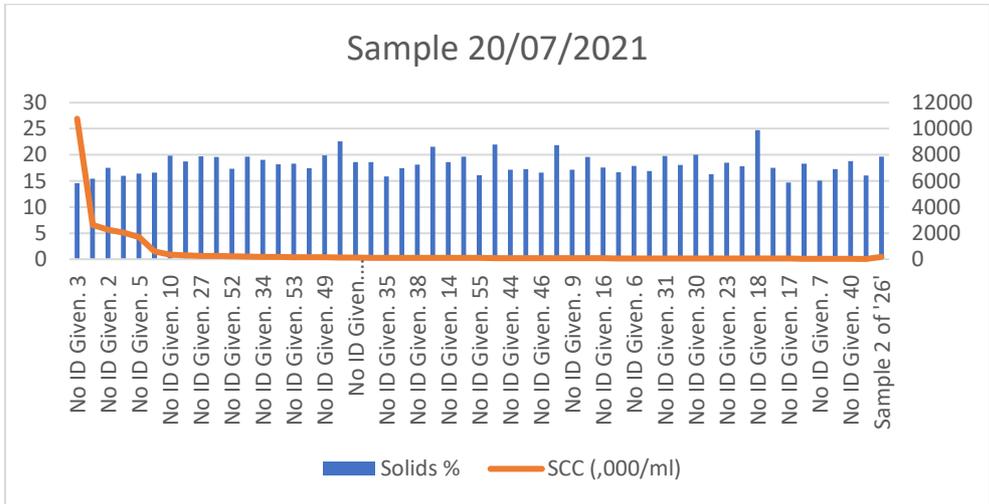
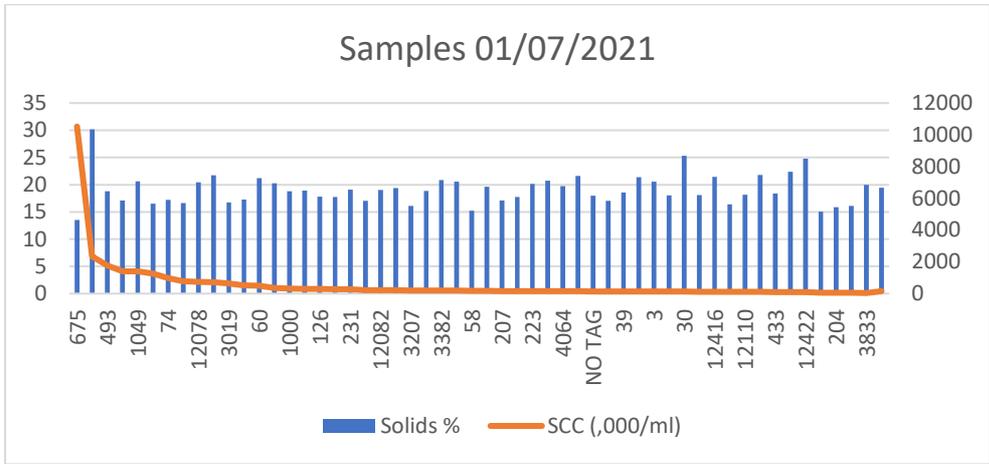
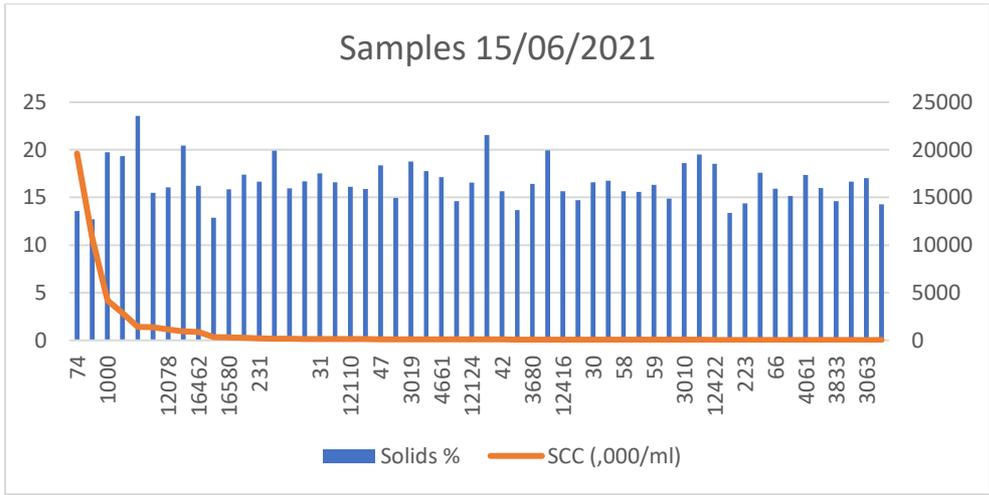
It is important to note that the presence of certain bacteria in the milk is a positive, natural occurrence. These bacteria, like *Lactococcus Lactis* and many others are non-pathogenic and help with the cheese production process, giving the product its unique flavour, somewhat similar to the importance of terroir in wine making.

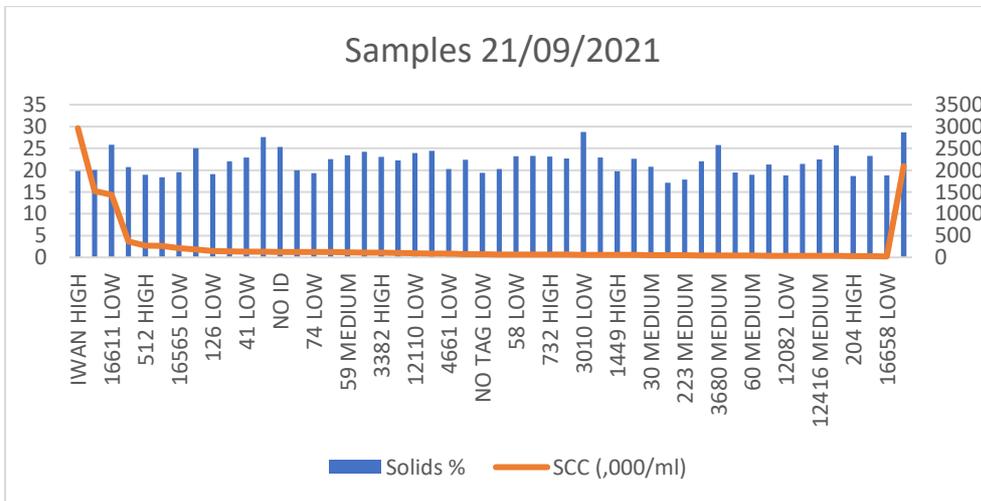
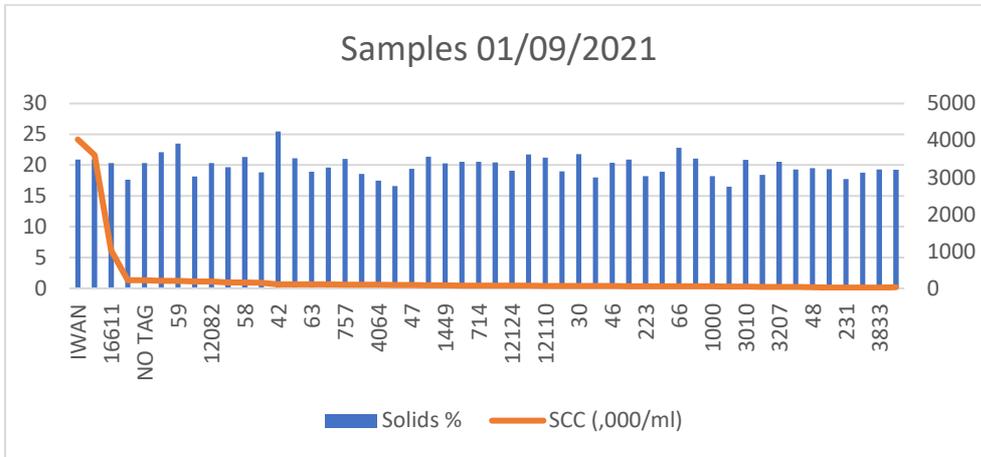
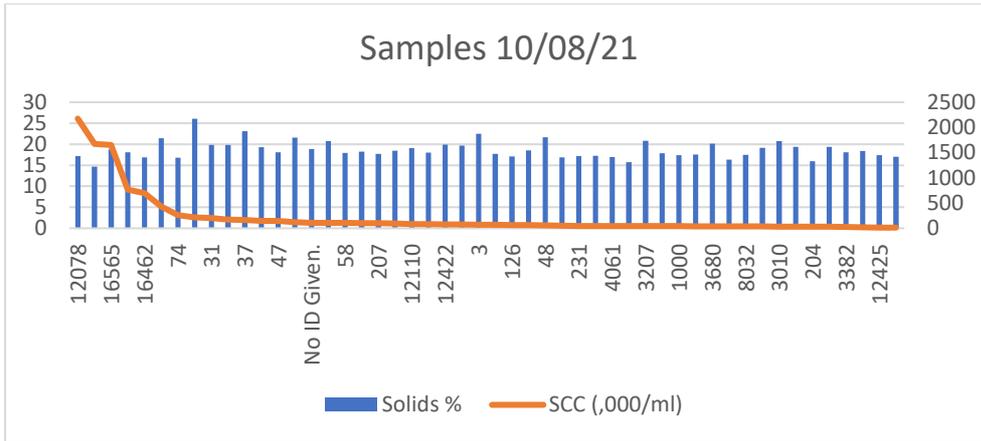
The project was not aimed at eliminating all bacteria in the milk but to allow the farm to identify animals which are chronically infected with pathogenic bacteria using milk samples as an indicator of udder health, and ewe productivity.

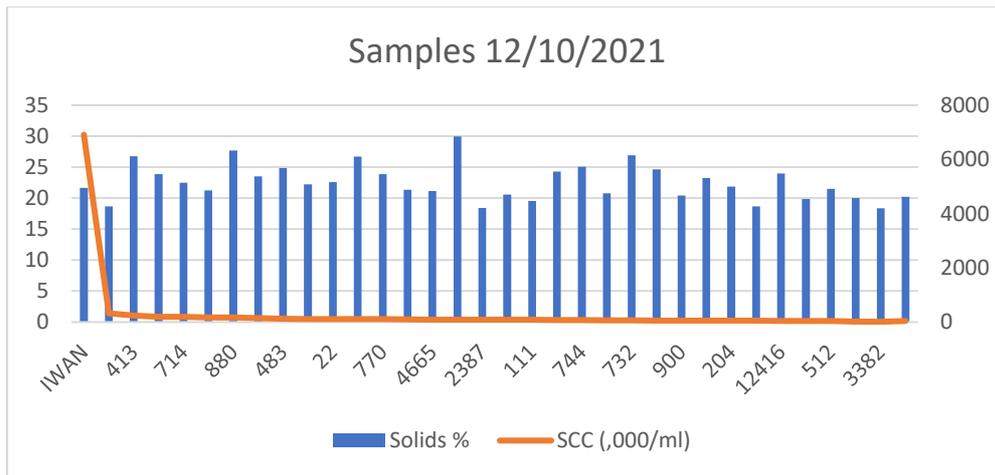
Total Solids results

As in Year 1, the percent of total solids in each milk sample, comprising of Butterfat, Protein and Lactose, were calculated for each sample analysed during year 2. The results were compared to each sample's SCC as seen below:









Unlike year 1, where some negative correlation was found between SCC and milk total solids in individual milk samples, no significant correlation was found in year 2 when comparing the averages of SCC and solids for each individual ewe.

As some samples were not individually identified or were missing, the average percentage of total solids throughout the season was also compared to the average of SCC of each ewe. No significant correlation between the two calculated averages was found.

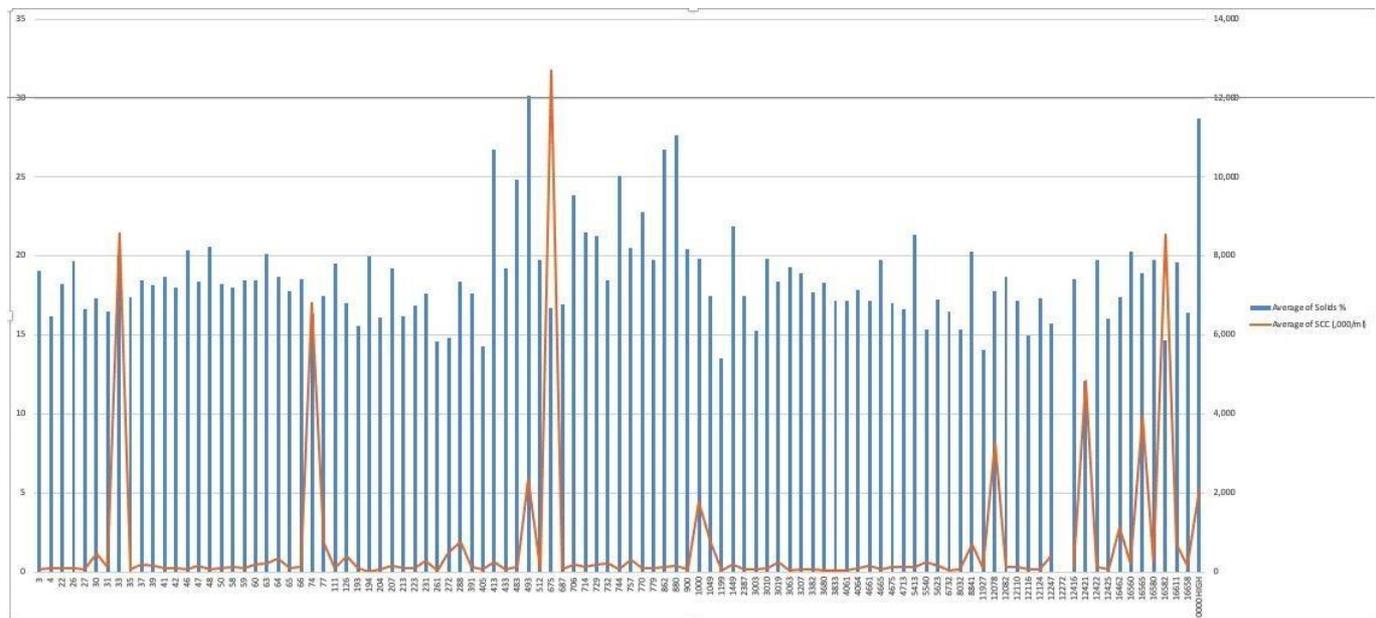


Fig 1: Average individual ewe SCC against Total solids

Bulk milk samples

Submission Date	Submission Number	Sample Number	Sample ID	SCC (000/ml)	Aerobic Plate Count (cfu/ml)	S. aureus Count (cfu/ml)	E. coli Count (cfu/ml)	Salmonella spp (Presence / Absence)	Listeria monocytogenes (Presence / Absence)	E. coli O157 (Presence / Absence)	Predominant Pathogen 1	Growth Level (B/N/H)	Predominant Pathogen 2	Growth Level
07/04/2021	21-04-0052	1	BULK	Not Tested	19,200	600	0	Not Tested	Not Tested	Not Tested	Staphylococcus aureus	H	Pseudomonas fluorescens	
27/04/2021	21-04-0325	1	BULK 25/4/21	Not Tested	>30,000	230	0	Absent	Absent	Absent	Pseudomonas fluorescens	H	Serratia liquefaciens	
19/05/2021	21-05-0276	1	BULK 17/5/21	734	>30,000	180	2	Absent	Absent	Absent	Pseudomonas fluorescens	H	Serratia liquefaciens	
15/06/2021	21-06-0191	1	No ID	1292	7,900	20	0	Absent	Absent	Absent	Lactococcus lactis	H	Streptococcus uberis	
01/07/2021	21-07-0017	1	No ID	1414	5,500	<10	35	Absent	Absent	Absent	Streptococcus uberis	H	Delftia acidovorans	
20/07/2021	21-07-0261	1	No ID	Clotted	>30,000	540	1	Absent	Absent	Absent	Pseudomonas fluorescens	H	Serratia liquefaciens	
10/08/2021	21-08-0107	1	BULK 9/8/21	1005	11,000	1,520	0	Absent	Absent	Absent	Pseudomonas fluorescens	H	Staphylococcus aureus	
01/09/2021	21-09-0013	1	BULK 1/9/21	294	10,500	370	1	Absent	Absent	Absent	Pseudomonas fluorescens	H	E. coli	
21/09/2021	21-09-0260	1	No ID	667	2,400	120	0	Absent	Absent	Absent	Enterococcus durans	H	Citrobacter gillenii	
12/10/2021	21-10-0274	1	No ID	154	>30,000	670	2	Absent	Absent	Absent	Staphylococcus aureus	H	Proteus hauseri	

Fig 2: Bulk milk sample results

Bulk milk tank samples were sent for analysis each time individual milk samples were collected.

Analysis of Bulk Milk Sample

The samples were analysed for SCC, Aerobic Plate Counts, *S.aureus* and *E.coli* counts, the presence of *Salmonella spp*, *Listeria Monocytogenes* and *E.coli* 0157 and general bacteriology. SCC were high in five of the seven qualifying samples. Aerobic Plate Counts were high in seven of the ten samples and *S.aureus* counts were higher than the 100 cfu/ml threshold (recommended by the BSDA and SCA). *E. coli* samples were below the coliform 100cfu/ml threshold on all of the samples and no *Salmonella*, *Listeria* or *E.coli* 0157 were cultured in each of the nine qualifying samples.

Pseudomonas fluorescens was cultured from six of the samples (07/04/2021, 27/04/2021, 19/05/2021, 20/07/2021, 10/08/2021 and 21/09/2021) and *staph aureus* was cultured from three of the samples (07/04/2021, 10/08/2021 and 12/10/2021). These two bacteria were also the predominant ones cultured in the year 1 bulk tank samples.

Staph aureus was identified as a major and minor pathogen in a few of the individual samples which could explain its presence as the predominant bacterium in two of the samples and a secondary bacterium in another. Its level was also above the recommended level suggested by BSDA and SCA standards in eight of the bulk samples.

As mentioned earlier, animals chronically infected with *S. aureus* would rarely cure and might only intermittently shed the bacteria in the milk making it more difficult to detect. However, they remain a constant risk if infection to other animals and to milk quality.

Pseudomonas fluorescens is a bacterium often associated with milk spoilage due to its proteolytic activity. It is a Psychotrophics bacteria able to survive at low temperature where it will outgrow other bacteria present.

As milk collection from the farm occurs every second day and even every three days if over the weekend, the time allowed for *Pseudomonas* multiplication is long and would explain its presence as a main pathogen in five, and a minor pathogen in one of the samples. This leads to the high level of bacterial Aerobic Plate Counts over and above the 10,000 cfu/ml threshold recommended by the BSDA and SCA for raw, unpasteurised milk and due to the bacteria's proteolytic activity, would reduce the overall milk total solids and the amount of cheese produced per kg of milk.

Cooling the milk to 2.5°C as soon as possible and sending the milk to the processors daily should lead to a reduction of the number of overall bacteria in the milk and to a better milk quality and cheese yield for the processor.

As water is a known source on *Pseudomonas* contamination, it was agreed following year 1 bulk milk tank results to sample mains water used in the milking parlour. Seven samples were sent on the 07/04/2021, 27/04/2021, 01/07/2021, 20/07/2021, 01/09/2021, 21/09/2021 and 12/10/2021. Samples were tested for Total Viable Plate Count (TVPC)- 2days, 37°C, TVPC- 3days, 22°C, Total and Faecal Coliforms, Faecal Streptococci and General microbiology:

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Submission Date	Submission Number	Sample Number	Sample ID	Total Viable Plate Count - 2 days, 37°C (cfu/ml)	Total Viable Plate Count - 3 days, 22°C (cfu/ml)	Coliforms, Total (Presumptive) (cfu/ml)	Coliforms, Faecal (cfu/ml)	Faecal Streptococci (cfu/ml)	Predominant Pathogen 1	Growth Level (S/N/H)	Predominant Pathogen 2	Growth Level (S/N/H)
1	07/04/2021	21-04-0044	1	07/04/2021	0	0	0	0	0	No growth			
2	27/04/2021	21-04-0323	1	25/04/2021	0	0	0	0	0	<i>Bacillus halosaccharovorans</i>	1	<i>Staphylococcus warneri</i>	1
3	01/07/2021	21-07-0016	1	No ID	0	0	0	0	0	No growth			
4	20/07/2021	21-07-0260	1	No ID	0	0	0	0	0	No growth			
5	01/09/2021	21-09-0012	1	WATER	0	0	0	0	0	No growth			
6	21/09/2021	21-09-0261	1	20/9	0	0	0	0	0	No growth			
7	12/10/2021	21-10-0173	1	No ID	0	0	0	0	0	No growth			

Fig 3: Water sample results.

Only one sample, taken on the 27/04/2021, cultured *Bacillus halosaccharovorans* and *Staph warneri* bacteria in small numbers. All other parameters were negative in all the samples taken.

As a water sample was not submitted on the 19th May when 18 individual milk samples cultured *Pseudomonas* positive, a small risk still exists of the water being the source of contamination. However, as the water quality in all the samples sent was high, and *Pseudomonas* was not cultured in any of the samples submitted, this risk is negligible.

This cluster of *Pseudomonas* positive results during one sampling date, and only a scatter of other positive samples during the season, with no ewes showing obvious signs of mastitis, indicate that the source of the *Pseudomonas* bacteria is contamination during milking or sampling. Milking routine should be reviewed to ensure there are no breakdowns in hygiene leading to contamination. Wearing gloves and being able to disinfect gloved hands if contaminated during milking should reduce the risk of bacterial contamination. The fact that this cluster of *Pseudomonas* positive results happened once only, indicates overall good, hygienic milking routine is practiced in the parlour.

Selenium supplementation results

Selenium supplementation continued for the Lleyn ewes identified as 15-30 as in year 1 of the project. Milk quality in those ewes was good and only one ewe, number 12078, with multiple high SCC, was identified as having chronic, sub clinical mastitis.

This is similar to the results seen in year 1. The results of this cohort are not significantly different from other ewes in the project, apart from the older, Friesland group of ewes, where more animals struggle with udder health issues.

As the ewes supplemented with selenium were introduced into the flock, halfway through year 1, as a group bought from an outside source, and were not randomly selected from within the flock, it is still difficult to assess the significance of the supplementation. The fact that the supplemented group's results were no different to the rest of the flock possibly indicates that selenium levels were adequate across the whole flock and supplementation is not essential.

Summary

The intended two-year project took place between 2019 and 2022 following disruption due to the global pandemic. Milk samples were taken during the 2019 and 2021 milking seasons. The ewes were kept under similar conditions all the way through the project and milked using the same milking parlour.

During the project, ewe numbers have increased from 45 to 135 ewes, all but a few are local Lleyn ewes. The farm and cheese maker are aiming for a pure Lleyn milking flock to produce a true native Welsh product as a source of pride and a unique selling point.

The Lleyn ewes adapted well to the milking parlour and milking routine and very few of them suffered from either acute or chronic mastitis. These results indicate that this native breed is well suited to being a productive breed for both meat and high-quality milk for human consumption.

The results also demonstrate that a “low input- low output” system, which relies on extensive grazing and a simple, well maintained milking parlour and farm set up, as practiced on the project's farm, is well suited to the Lleyn breed and to diary sheep farming in Wales.

156 individual milk samples and four bulk tank samples were taken in the first year and 584 individual milk samples and 10 bulk tank samples were taken in year 2. After year 1, when 61 Nasal swabs were taken and no correlation was found between bacterial populations in the nose and the udder of each sampled ewe, this was discontinued and instead, more individual milk samples, and 7 mains water samples were taken in year 2.

Conclusions

Drawing accurate conclusions from an “on farm” project is never an easy task as time, practicalities and budget constraints are always in play. The global pandemic also “provided” many difficult challenges which interfered with day-to-day life, farming, and project continuity. The farm staff did well to adhere to the project guidelines and provided high quality samples (despite this being extremely difficult at times) so useful information could be obtained on both the project years.

The project demonstrated the many types of bacteria present in milk, few of them are pathogenic while most of them not. By monitoring Somatic Cell Counts and looking at bacterial plate counts the farm was able to identify ewes which were chronically infected with sub clinical mastitis. This has helped the farm to select the right ewes going forward and improve further their level of production and milk quality.

Reducing the overall number of pathogenic bacteria such as *Staphylococci spp* and *Pseudomonas fluorescens* is always a challenge but removing ewes with chronic infections, keeping the ewes in good health, milking them when the udder is clean and dry, and observing overall good milking hygiene, will ensure even better results in the future. Cooling the milk in the tank quickly down to 2.5°C and frequent, if possible, daily milk collection, will help further progress to be made with both the farm and the cheese making processor benefiting from the increase in milk quality.

Acknowledgements

My thanks go to Geraint Hughes and Meinir Jones for their invitation to participate in this project and to Dr Carrie Rimes & Alan Parry Jones and his family, who all worked tirelessly, under difficult conditions, to ensure the project could be completed despite the constraints imposed by the global pandemic, and a meaningful set of results could be produced. Meeting with them and all other members of the project team, to discuss milk quality, milk and cheese production, and overall farming practices in north Wales has taught me a lot and for that I am forever grateful.

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Appendix

Appendix 1 - Individual Milk Sample results

Substrate ID	Substrate Name	No. of Samples	Sample ID	Aerobic				Colony Count (CFU/ml)	Pathogen 1	Pathogen 2	Pathogen 3	Pathogen 4	Pathogen 5
				CFU/ml	CFU/ml	CFU/ml	CFU/ml						
07/04/2021	21-04-0045	1	74	5.59	4.55	5.33	1940	>30,000	Lactococcus lactis	21	Staphylococcus coliform	4	
07/04/2021	21-04-0045	2	16565	9.02	4.85	5.04	932	420	Lactococcus lactis	2	Staphylococcus warneri	2	
07/04/2021	21-04-0045	3	16582	6.72	5.48	4.60	8564	780	Staphylococcus epidermidis	10	Lactococcus lactis	1	
07/04/2021	21-04-0045	4	126	5.95	4.93	5.44	34	130	Staphylococcus warneri	1	Corynebacterium sp.	1	
07/04/2021	21-04-0045	5	16462	6.68	5.76	4.90	939	900	Staphylococcus epidermidis	21	Staphylococcus equorum	21	
07/04/2021	21-04-0045	6	96	7.45	5.03	5.08	75	630	Corynebacterium xerosis	7	Psychrobacter arcticus	3	Micrococcus luteus
07/04/2021	21-04-0045	7	16658	8.34	4.79	4.94	568	90	Corynebacterium xerosis	2	Kocuria carniphila	2	
07/04/2021	21-04-0045	8	16580	11.96	7.12	4.53	161	22,700	Psychrobacter phenylpyruvicus	21	Staphylococcus sp.	10	
07/04/2021	21-04-0045	9	231	7.25	4.77	4.87	73	1,340	Kocuria carniphila	9	Corynebacterium xerosis	5	Psychrobacter sp.
07/04/2021	21-04-0045	10	16611	5.54	5.61	4.92	86	1,090	Psychrobacter sp.	21	Corynebacterium xerosis	21	Kocuria carniphila
07/04/2021	21-04-0045	11	42	7.27	5.51	4.80	100	15	Staphylococcus pasteurii	2	Staphylococcus pasteurii	2	
07/04/2021	21-04-0045	12	4064	3.57	4.98	5.74	83	270	Staphylococcus aureus	18	Psychrobacter sp.	8	
07/04/2021	21-04-0045	13	22	4.26	4.86	5.42	35	40	No growth				
07/04/2021	21-04-0045	14	3207	7.17	5.88	4.86	51	10	Staphylococcus equorum	1	Corynebacterium sp.	1	
07/04/2021	21-04-0045	15	1030	9.81	6.38	4.65	811	1,280	Staphylococcus aureus	21	Corynebacterium lipophiloflavum	2	Corynebacterium xerosis
07/04/2021	21-04-0045	16	223	6.53	5.09	4.85	47	90	Staphylococcus equorum	4	Corynebacterium sp.	2	
07/04/2021	21-04-0045	17	204	4.84	4.53	5.39	38	210	Leuconostoc lactis	2	Corynebacterium xerosis	2	
07/04/2021	21-04-0045	18	3010	6.83	5.42	4.63	21	90	Corynebacterium lipophiloflavum	4	Staphylococcus haemolyticus	1	
07/04/2021	21-04-0045	19	30	3.77	5.16	4.77	2469	12	Corynebacterium xerosis	1			
07/04/2021	21-04-0045	20	37	8.16	5.93	4.52	336	30	Leuconostoc mesenteroides	1	Staphylococcus warneri	1	
07/04/2021	21-04-0045	21	3063	6.13	5.00	4.79	23	240	Psychrobacter arcticus	3	Corynebacterium sp.	3	
07/04/2021	21-04-0045	22	12078	8.17	5.26	4.96	9413	1,000	Staphylococcus chromogenes	18			
07/04/2021	21-04-0045	23	31	3.31	5.65	5.21	42	90	Staphylococcus warneri	4			
07/04/2021	21-04-0045	24	3382	8.10	5.26	4.94	47	230	Staphylococcus equorum	3	Staphylococcus epidermidis	1	Corynebacterium lipophiloflavum
07/04/2021	21-04-0045	25	47	7.66	6.09	4.94	115	50	Staphylococcus warneri	5	Neisseria subflava	2	
07/04/2021	21-04-0045	26	63	7.65	4.93	5.16	109	510	Staphylococcus chromogenes	21	Staphylococcus warneri	21	Staphylococcus pasteurii
07/04/2021	21-04-0045	27	58	8.04	6.38	4.74	52	570	Trueperella pyogenes	21	Staphylococcus chromogenes	4	Bacillus pumilus
07/04/2021	21-04-0045	28	1449	11.35	6.09	4.76	159	2,400	Staphylococcus warneri	21	Corynebacterium sp.	21	
07/04/2021	21-04-0045	29	3	4.86	5.85	4.96	46	270	Corynebacterium lipophiloflavum	7	Staphylococcus pasteurii	2	Kocuria carniphila
07/04/2021	21-04-0045	30	41	8.64	5.63	4.64	80	110	Staphylococcus warneri	2	Corynebacterium sp.	2	
07/04/2021	21-04-0045	31	12416	5.45	6.19	4.80	273	890	Corynebacterium sp.	10	Staphylococcus warneri	3	Sphingomonas sp.
07/04/2021	21-04-0045	32	8032	1.34	4.25	5.11	8	1,000	Psychrobacter sp.	4	Bacillus mycoloides	2	Corynebacterium xerosis
07/04/2021	21-04-0045	33	1049	8.21	4.97	4.66	64	40	Staphylococcus chromogenes	1			
07/04/2021	21-04-0045	34	757	9.91	5.90	4.54	57	30	Neisseria subflava	1			
07/04/2021	21-04-0045	35	12082	9.87	5.06	4.93	104	110	Kocuria carniphila	3	Bacillus subtilis	1	
07/04/2021	21-04-0045	36	213	5.73	5.06	4.97	65	100	Corynebacterium xerosis	4	Corynebacterium lipophiloflavum	3	Psychrobacter sp.
07/04/2021	21-04-0045	37	33	10.62	5.75	4.06	4304	>30,000	Streptococcus dysgalactiae	21			
07/04/2021	21-04-0045	38	59	4.53	5.79	5.33	57	470	Staphylococcus warneri	6	Psychrobacter phenylpyruvicus	1	
07/04/2021	21-04-0045	39	12110	2.13	5.56	5.48	56	380	Corynebacterium xerosis	5	Staphylococcus aureus	3	Psychrobacter arcticus
07/04/2021	21-04-0045	40	65	6.80	5.09	5.10	55	1,120	Staphylococcus warneri	6	Corynebacterium xerosis	3	Corynebacterium lipophiloflavum
07/04/2021	21-04-0045	41	433	6.49	5.87	4.85	44	1,600	Staphylococcus aureus	21	Kocuria carniphila	5	
07/04/2021	21-04-0045	42	3680	5.46	5.22	5.08	22	2,100	Psychrobacter sp.	21	Staphylococcus chromogenes	21	Corynebacterium xerosis
07/04/2021	21-04-0045	43	NO TAG	4.71	5.95	4.99	90	220	Corynebacterium lipophiloflavum	4	Staphylococcus equorum	4	
07/04/2021	21-04-0045	44	50	7.60	5.56	4.92	60	90	Corynebacterium lipophiloflavum	4	Corynebacterium xerosis	1	
07/04/2021	21-04-0045	45	3833	4.72	5.15	5.32	19	1,410	Psychrobacter numhaemalis	10	Staphylococcus warneri	2	Staphylococcus equorum
07/04/2021	21-04-0045	46	60	7.47	5.25	5.16	73	40	No growth				
07/04/2021	21-04-0045	47	48	8.74	5.51	4.52	48	310	Adrenella inornata	1	Corynebacterium lipophiloflavum	1	
07/04/2021	21-04-0045	48	3019	5.31	5.16	4.70	106	670	Corynebacterium sp.	5	Staphylococcus warneri	1	Staphylococcus equorum
07/04/2021	21-04-0045	49	4661	4.48	4.79	5.16	27	500	Kocuria carniphila	7	Staphylococcus warneri	1	
07/04/2021	21-04-0045	50	12422	8.03	7.82	4.20	355	10	Psychrobacter sp.	1	Staphylococcus equorum	1	Corynebacterium lipophiloflavum
07/04/2021	21-04-0045	51	12124	3.65	5.16	5.39	30	10	Corynebacterium lipophiloflavum	6	Psychrobacter phenylpyruvicus	1	
07/04/2021	21-04-0045	52	39	7.97	5.94	4.42	236	40	Staphylococcus warneri	21			
07/04/2021	21-04-0045	53	732	5.81	5.04	5.23	29	1,100	Corynebacterium lipophiloflavum	3	Corynebacterium xerosis	3	Staphylococcus sp.

Fig 4: Milk sample results 07/04/2021

Subm ID	Subm Name	SS	Sample ID	Aseptic Plate Counts				Conventional Antibiotic Resist	Pathogen 1			Pathogen 2			Pathogen 3			Date
				CFU	CFU	CFU	CFU		CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU	
55	27/04/2021	21-04-0324	1	74	8.36	5.35	4.50	13288	130	Staphylococcus microti	2							
56	27/04/2021	21-04-0324	2	16565	9.12	7.13	3.68	19578	500	Staphylococcus epidermidis	6	Corynebacterium mastitidis	2					
57	27/04/2021	21-04-0324	3	16562	7.34	5.23	4.51	8379	400	Staphylococcus epidermidis	21	Staphylococcus pasteurii	2					
58	27/04/2021	21-04-0324	4	126	6.10	5.07	5.34	108	20	No growth								
59	27/04/2021	21-04-0324	5	16462	8.30	5.78	4.73	1883	110	Staphylococcus epidermidis	2							
60	27/04/2021	21-04-0324	6	66	7.58	5.26	4.91	160	10	No growth								
61	27/04/2021	21-04-0324	7	16658	7.45	4.71	4.95	145	7	Kocuria camphila	1							
62	27/04/2021	21-04-0324	8	N/A	-	-	-	-										NO SAMPLE PRESENT
63	27/04/2021	21-04-0324	9	231	10.96	5.38	4.46	1467	280	Corynebacterium sp	1	Microbacterium phytothlaserae	1	Staphylococcus warneri	1			
64	27/04/2021	21-04-0324	10	16550	9.70	6.12	4.47	220	20	No growth								
65	27/04/2021	21-04-0324	11	42	9.12	5.49	4.73	106	60	Psychrobacterium nummiformis	8	Corynebacterium xerosis	3	Staphylococcus pasteurii	1			
66	27/04/2021	21-04-0324	12	N/A	-	-	-	-	130	Psychrobacter arcticus	1	Staphylococcus epidermidis	1	Staphylococcus warneri	1			
67	27/04/2021	21-04-0324	13	22	8.89	5.05	4.77	101	100	Psychrobacter sp	1	Corynebacterium xerosis	1					
68	27/04/2021	21-04-0324	14	3207	8.90	5.78	4.56	68	30	Corynebacterium xerosis	1							
69	27/04/2021	21-04-0324	15	1000	8.34	6.66	4.60	2516	340	Staphylococcus aureus	11	Staphylococcus warneri	2					
70	27/04/2021	21-04-0324	16	223	11.40	5.22	4.13	169	10	No growth								
71	27/04/2021	21-04-0324	17	204	6.20	4.64	5.25	93	40	Psychrobacter arcticus	5	Corynebacterium xerosis	2	Psychrobacter phenylpyruvicus	1			
72	27/04/2021	21-04-0324	18	3010	10.83	5.64	3.97	252	10	No growth								
73	27/04/2021	21-04-0324	19	30	7.62	5.32	4.68	242	0	No growth								
74	27/04/2021	21-04-0324	20	37	8.08	5.75	4.44	82	10	No growth								
75	27/04/2021	21-04-0324	21	3063	7.08	5.56	4.57	23	20	Mycobacterium sp								
76	27/04/2021	21-04-0324	22	12078	6.57	5.62	4.92	4685	860	Staphylococcus chromogenes								
77	27/04/2021	21-04-0324	23	31	7.59	5.27	4.54	155	0	No growth								
78	27/04/2021	21-04-0324	24	3382	6.46	5.63	4.78	44	20	Staphylococcus epidermidis	0	Staphylococcus pasteurii	9	Corynebacterium casei	1			
79	27/04/2021	21-04-0324	25	47	8.21	5.90	4.64	272	10	Bacillus mycoloides	1							
80	27/04/2021	21-04-0324	26	63	11.32	5.47	4.68	158	10	No growth								
81	27/04/2021	21-04-0324	27	58	-	-	-	-										NO SAMPLE PRESENT
82	27/04/2021	21-04-0324	28	1449	13.00	6.64	4.28	327	40	Pseudomonas fluorescens	1	Staphylococcus warneri	1					
83	27/04/2021	21-04-0324	29	391	6.75	6.36	4.54	111	10	Corynebacterium xerosis	1							
84	27/04/2021	21-04-0324	30	41	-	-	-	-										NO SAMPLE PRESENT
85	27/04/2021	21-04-0324	31	12416	7.88	6.05	4.72	117	10	Psychrobacter arcticus	2							
86	27/04/2021	21-04-0324	32	8032	5.68	5.83	4.07	152	710	Psychrobacter arcticus	2							
87	27/04/2021	21-04-0324	33	1049	-	-	-	-										NO SAMPLE PRESENT
88	27/04/2021	21-04-0324	34	757	10.02	5.50	4.45	121	300	Psychrobacter arcticus	4	Lactococcus amnigenus	1	Citrobacter koseri	1	Y		
89	27/04/2021	21-04-0324	35	12882	10.81	5.31	4.69	141	20	Aerococcus viridans	21	Psychrobacter arcticus						
90	27/04/2021	21-04-0324	36	213	7.80	4.76	4.60	202	2	No growth								
91	27/04/2021	21-04-0324	37	33	9.79	7.12	2.77	12810	20000	Streptococcus dysgalactiae	21	Staphylococcus warneri	2					
92	27/04/2021	21-04-0324	38	3382	5.77	5.75	5.13	95	10	Psychrobacter arcticus	1	Brevibacterium lincolnum	1					
93	27/04/2021	21-04-0324	39	12110	7.82	5.81	4.93	313	0	No growth								
94	27/04/2021	21-04-0324	40	65	7.71	4.89	4.76	82	200	Psychrobacter phenylpyruvicus	3	Corynebacterium xerosis	3	Micrococcus sp	3	Y		
95	27/04/2021	21-04-0324	41	433	6.19	6.34	4.58	63	20	Psychrobacter arcticus	6	Psychrobacter phenylpyruvicus	5	Staphylococcus equorum	4			
96	27/04/2021	21-04-0324	42	N/A	-	-	-	-										NO SAMPLE PRESENT
97	27/04/2021	21-04-0324	43	NO TAG	5.85	6.02	4.79	110	640	Staphylococcus warneri	10							
98	27/04/2021	21-04-0324	44	50	8.21	5.56	4.54	94	20	No growth								
99	27/04/2021	21-04-0324	45	3833	6.39	5.10	4.89	62	10	No growth								
100	27/04/2021	21-04-0324	46	60	-	-	-	-										NO SAMPLE PRESENT
101	27/04/2021	21-04-0324	47	48	8.71	5.52	4.48	80	10	Staphylococcus equorum	1	Staphylococcus aureus	1					
102	27/04/2021	21-04-0324	48	3019	7.46	5.06	4.65	245	100	Psychrobacter arcticus	4	Corynebacterium xerosis	1					
103	27/04/2021	21-04-0324	49	4661	8.72	4.81	3.51	150	10	Staphylococcus warneri	1							
104	27/04/2021	21-04-0324	50	NO ID on paperwork	13.09	5.52	3.77	250	7	Staphylococcus warneri	1							No Sheep ID on Paperwork
105	27/04/2021	21-04-0324	51	12124	6.68	5.58	4.61	62	10	No growth								
106	27/04/2021	21-04-0324	52	NO ID on paperwork	9.30	5.94	4.33	160	1	Corynebacterium xerosis	1							No Sheep ID on Paperwork
107	27/04/2021	21-04-0324	53	NO ID on paperwork	-	-	-	-	70	Staphylococcus haemolyticus	1	Corynebacterium lipophilum	1					No Sheep ID on Paperwork
108	27/04/2021	21-04-0324	54	12425	7.87	4.62	5.03	78	140	Serratia fonticola	1	Acinetobacter sp	1	Corynebacterium sp	1			
109	27/04/2021	21-04-0324	55	4713	10.59	5.29	4.42	258	600	Psychrobacter arcticus	6	Corynebacterium xerosis	1					

Fig 5: Milk sample results 27/04/2021

Subm ID	Subm Name	SS	Sample ID	Aseptic Plate Counts				Conventional Antibiotic Resist	Pathogen 1			Pathogen 2			Pathogen 3			Date
				CFU	CFU	CFU	CFU		CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU	
110	19/05/2021	21-05-0277	1	74	5.64	5.06	4.02	17525	5000	Staphylococcus microti	21	Lactococcus lactis	3	Psychrobacter phenylpyruvicus	1			
111	19/05/2021	21-05-0277	2	16565	5.72	5.58	5.10	521	5,800	Staphylococcus epidermidis	21	Staphylococcus warneri	21					
112	19/05/2021	21-05-0277	3	16582	4.97	4.88	3.48	11302	9,100	Staphylococcus epidermidis	21	Psychrobacter immobilis	10	E. coli	6	Y		
113	19/05/2021	21-05-0277	4	126	5.06	6.62	4.77	841	760	Psychrobacter sp.	21	Staphylococcus aureus	1	E. coli	2	Y		
114	19/05/2021	21-05-0277	5	16462	7.04	6.19	4.69	13041	3,300	Staphylococcus epidermidis	21							
115	19/05/2021	21-05-0277	6	66	4.52	5.82	5.09	48	810	Corynebacterium xerosis	21	Brevibacterium lincolnum	4	Pantoea agglomerans	1	Y		
116	19/05/2021	21-05-0277	7	16658	6.14	5.04	5.03	59	910	Psychrobacter phenylpyruvicus	1	Staphylococcus sp	1	Corynebacterium lipophilum	1			
117	19/05/2021	21-05-0277	8	16580	-	-	-	-										NO SAMPLE PRESENT
118	19/05/2021	21-05-0277	9	231	4.93	5.70	5.04	71	70	No growth								
119	19/05/2021	21-05-0277	10	16611	10.61	7.37	4.28	601	>30,000	Pseudomonas fluorescens	21	Pantoea agglomerans	21	Erwinia persici	21	Y		
120	19/05/2021	21-05-0277	11	42	3.96	6.23	4.57	51	30	Psychrobacter arcticus	21	Arthrobacter gandavensis	21	Corynebacterium sp	1			
121	19/05/2021	21-05-0277	12	4064	8.44	5.82	4.74	82	50	Psychrobacter arcticus	8	Paenibacillus phoenicis	1					
122	19/05/2021	21-05-0277	13	22	2.76	6.04	5.18	92	>30,000	Psychrobacter nummiformis	21	Corynebacterium sp	12	Enterococcus hirae	5			
123	19/05/2021	21-05-0277	14	3207	5.14	6.28	4.39	56	130	Corynebacterium xerosis	5	Staphylococcus equorum	1					
124	19/05/2021	21-05-0277	15	1000	8.57	7.38	4.04	5976	8									

ID	Substrate	Substrate Name	Substrate No.	Sample No.	Sample Name	Bact	Fungi	E Coli	Colony Count	Compositional Analysis Index	Aerobic Plate Count (APC)		Pathogen 1		Pathogen 2		Pathogen 3		Pathogen 4	Pathogen 5	Pathogen 6	
											CFU/ml	CFU/ml	CFU/ml	CFU/ml	CFU/ml	CFU/ml	CFU/ml	CFU/ml				
310	20/07/2021	21-07-0262	1	No ID Given	1	6.42	5.75	3.81	2042		10	Staphylococcus epidermidis	1	Staphylococcus aureus								
311	20/07/2021	21-07-0262	2	No ID Given	2	7.89	5.38	4.27	2253		10,300	Staphylococcus epidermidis	21									
312	20/07/2021	21-07-0262	3	No ID Given	3	5.24	5.41	3.92	10705		7,800	Pseudomonas fluorescens	21	Staphylococcus epidermidis		21	E. coli				1	Y
313	20/07/2021	21-07-0262	4	No ID Given	4	6.23	6.33	4.89	110		350	Pseudomonas fluorescens	21	Acinetobacter sp.		21	E. coli				1	
314	20/07/2021	21-07-0262	5	No ID Given	5	8.24	6.00	4.17	1689		13,300	Staphylococcus equorum	21	Staphylococcus equorum		5						
315	20/07/2021	21-07-0262	6	No ID Given	6	6.33	6.95	4.58	67		360	Staphylococcus equorum	1	Staphylococcus vitulinus		1						
316	20/07/2021	21-07-0262	7	No ID Given	7	5.16	4.98	4.95	36		9,100	Pantoea agglomerans	21	Enterobacteriaceae		21						
317	20/07/2021	21-07-0262	8	No ID Given	8	9.98	8.12	3.76	79		40	Staphylococcus sp.	1	Corynebacterium sp.		1						
318	20/07/2021	21-07-0262	9	No ID Given	9	6.30	6.18	4.67	78		50	Pseudomonas fluorescens	13									
319	20/07/2021	21-07-0262	10	No ID Given	10	8.08	7.35	4.40	344		7,600	Pantoea agglomerans	21	Arthrobacter gandavensis		21	Neisseria subflava				3	Y
320	20/07/2021	21-07-0262	11	No ID Given	11	8.65	7.09	3.87	243		210	Pseudomonas fluorescens	2	Rothia amarae		1	Staphylococcus xylosum				1	
321	20/07/2021	21-07-0262	12	No ID Given	12	7.97	5.88	4.43	39		150	Staphylococcus equorum	1									
322	20/07/2021	21-07-0262	13	No ID Given	13	6.70	6.76	4.63	63		20	Acinetobacter kefflii	1	Psychrobacter arcticus		1						
323	20/07/2021	21-07-0262	14	No ID Given	14	7.18	7.33	4.07	102		10	Corynebacterium lipophilum	1									
324	20/07/2021	21-07-0262	15	No ID Given	15	6.23	6.38	4.67	26		10	Staphylococcus equorum	1									
325	20/07/2021	21-07-0262	16	No ID Given	16	7.88	5.53	4.13	72		250	Staphylococcus sp.	1									
326	20/07/2021	21-07-0262	17	No ID Given	17	3.81	5.52	5.36	44		30	Staphylococcus aureus	1									
327	20/07/2021	21-07-0262	18	No ID Given	18	13.77	7.26	3.72	48		940	Pseudomonas fluorescens	5	E. coli		5	Enterobacteriaceae				5	Y
328	20/07/2021	21-07-0262	19	No ID Given	19	8.57	6.43	4.61	78		7,200	Pseudomonas fluorescens	21	Staphylococcus chromogenes		1						
329	20/07/2021	21-07-0262	20	No ID Given	20	7.33	6.96	3.15	147		190	Staphylococcus xylosum	18	E. coli		1						
330	20/07/2021	21-07-0262	21	No ID Given	21	6.63	6.39	4.47	45		10	Corynebacterium lipophilum	1									
331	20/07/2021	21-07-0262	22	No ID Given	22	6.23	6.10	4.23	600		4,100	Staphylococcus chromogenes	21	Pseudomonas fluorescens		1	Staphylococcus xylosum				1	
332	20/07/2021	21-07-0262	23	No ID Given	23	7.02	6.84	4.61	59		120	Pseudomonas fluorescens	21	Citrobacter gillenii		21						
333	20/07/2021	21-07-0262	24	No ID Given	24	5.12	6.98	4.53	68		320	Pantoea agglomerans	3	Staphylococcus equorum		1						
334	20/07/2021	21-07-0262	25	No ID Given	25	8.47	6.62	4.56	204		10	No growth										
335	20/07/2021	21-07-0262	26	Given	26 Sample 1 of 2	7.89	6.24	4.50	133		10	No growth										
336	20/07/2021	21-07-0262	27	No ID Given	27	9.10	7.51	3.12	254		2,600	Arthrobacter gandavensis	21	Staphylococcus chromogenes		21	Staphylococcus aureus				21	Y
337	20/07/2021	21-07-0262	28	No ID Given	28	-	-	-	-	NO SAMPLE PRESENT												
338	20/07/2021	21-07-0262	29	No ID Given	29	10.38	8.00	3.62	92		20	Aeromonas eucnemophila	1									
339	20/07/2021	21-07-0262	30	No ID Given	30	7.74	7.70	4.56	63		>30,000	Pseudomonas fluorescens	21	Acinetobacter sp.		21						
340	20/07/2021	21-07-0262	31	No ID Given	31	7.64	7.34	4.79	65		10	Staphylococcus aureus	1									
341	20/07/2021	21-07-0262	32	No ID Given	32	5.67	6.88	3.76	63		10,100	E. coli	21	Acinetobacter sp.		21	Glutamicibacter protophormiae				21	Y
342	20/07/2021	21-07-0262	33	No ID Given	33	4.84	6.32	4.30	2629		1,960	Streptococcus uberis	21	Arthrobacter gandavensis		18	Staphylococcus equorum				5	
343	20/07/2021	21-07-0262	34	No ID Given	34	8.40	6.23	4.42	183		1,540	Pseudomonas fluorescens	21	Aeromonas eucnemophila		21	Arthrobacter gandavensis				21	Y
344	20/07/2021	21-07-0262	35	No ID Given	35	4.81	6.20	4.85	113		2,540	Pseudomonas fluorescens	5	Pantoea agglomerans		5	Staphylococcus simulans				5	Y
345	20/07/2021	21-07-0262	36	No ID Given	36	-	-	-	-	NO SAMPLE PRESENT												
346	20/07/2021	21-07-0262	37	No ID Given	37	-	-	-	-	NO SAMPLE PRESENT												
347	20/07/2021	21-07-0262	38	No ID Given	38	6.50	7.14	4.50	108		9,000	Pseudomonas sp.	12	Arthrobacter gandavensis		11	Aeromonas salmonicida				2	Y
348	20/07/2021	21-07-0262	39	No ID Given	39	5.87	7.30	4.62	56		750	Aerococcus viridans	1									
349	20/07/2021	21-07-0262	40	No ID Given	40	8.31	6.20	4.28	23		580	Staphylococcus hominis	1									
350	20/07/2021	21-07-0262	41	No ID Given	41	9.33	8.28	3.91	105		270	Arthrobacter gandavensis	1	Staphylococcus hominis		1	Staphylococcus equorum				1	
351	20/07/2021	21-07-0262	42	No ID Given	42	7.54	6.66	4.52	305		1,270	Arthrobacter citreus	11	Bacillus mycoloides		1	Staphylococcus succinus				1	
352	20/07/2021	21-07-0262	43	No ID Given	43	7.94	6.94	3.70	114		390	Staphylococcus aureus	4									
353	20/07/2021	21-07-0262	44	No ID Given	44	6.24	6.25	4.63	87		50	Micrococcus luteus	1									
354	20/07/2021	21-07-0262	45	No ID Given	45	5.60	5.59	4.78	18		28,900	Yersinia frederiksenii	21	Staphylococcus equorum		21	Serratia fonticola				1	Y
355	20/07/2021	21-07-0262	46	No ID Given	46	5.24	6.33	5.02	81		3,400	Pantoea agglomerans	21	Aerococcus viridans		3						
356	20/07/2021	21-07-0262	47	No ID Given	47	7.97	7.61	4.10	102		720	Pseudomonas fluorescens	1	Citrobacter gillenii		1						
357	20/07/2021	21-07-0262	48	No ID Given	48	7.09	7.25	3.84	176		1,540	Arthrobacter gandavensis	6	ARTHROBACTER OTREUS		6	Staphylococcus xylosum				1	
358	20/07/2021	21-07-0262	49	No ID Given	49	8.82	7.04	4.02	146		2,700	Pseudomonas fluorescens	10	Staphylococcus equorum		10						
359	20/07/2021	21-07-0262	50	No ID Given	50	11.48	7.21	3.92	138		10	Corynebacterium lipophilum	1									
360	20/07/2021	21-07-0262	51	No ID Given	51	6.94	5.85	4.49	86		300	Staphylococcus equorum	4									
361	20/07/2021	21-07-0262	52	No ID Given	52	6.99	6.34	3.98	217		60	Pseudomonas fluorescens	5									
362	20/07/2021	21-07-0262	53	No ID Given	53	7.93	5.67	4.70	164		470	Pseudomonas fluorescens	2									
363	20/07/2021	21-07-0262	54	No ID Given	54	6.39	5.54	4.96	67		150	Staphylococcus equorum	2	Pseudomonas fluorescens		1						
364	20/07/2021	21-07-0262	55	No ID Given	55	5.34	6.35	4.39	94		70	Acinetobacter kefflii	14									
365	20/07/2021	21-07-0262	56	Sample 2 of 2	26	8.73	6.32	4.62	168		40	No growth										

Fig 9: Milk sample results 20/07/2021

ID	Submittal Date	Submittal Name	Submittal Ref	Sample ID	But	M	U	S	T	Concentration of Analyte in Sample	Aerobic Plate Count (CFU)	Pathogen 1			Pathogen 2			Pathogen 3			Y	
												CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU	CFU		
366	10/08/2021	21-08-0108	1	74	6.55	5.88	4.37	258			740	Staphylococcus microti	12	Staphylococcus auricularis	2							
367	10/08/2021	21-08-0108	2	16565	8.38	6.34	4.02	1654			10,000	Staphylococcus epidermidis	21	Staphylococcus equorum	6	E. coli				1	Y	
368	10/08/2021	21-08-0108	3	16582	5.77	5.26	3.62	1670			>30,000	Staphylococcus epidermidis	21									
369	10/08/2021	21-08-0108	4	126	5.69	6.60	4.81	66			90	Denkovaia turbata	2									
370	10/08/2021	21-08-0108	5	16462	6.63	6.24	3.96	694			2,300	Staphylococcus epidermidis	21	Acinetobacter sp.	1							
371	10/08/2021	21-08-0108	6	66	8.16	7.07	4.13	33			10	Streptococcus luteolus	1	Staphylococcus auricularis	1							
372	10/08/2021	21-08-0108	7	16558	6.23	5.31	4.83	37			660	E. coli	5	Lactobacillus arborigenus	5	Arthrobacter gandivensis	5			5	Y	
373	10/08/2021	21-08-0108	8	207	12.82	9.92	3.30	218			30	Streptococcus luteolus	1	Staphylococcus auricularis	1	Staphylococcus equorum	1					
374	10/08/2021	21-08-0108	9	231	6.13	6.44	4.59	46			10	No growth										
375	10/08/2021	21-08-0108	10	16611	6.74	6.99	4.33	764			10	Corynebacterium xerosis	1									
376	10/08/2021	21-08-0108	11	42	-	-	-	-	NO SAMPLE PRESENT													
377	10/08/2021	21-08-0108	12	4061	6.31	6.53	4.14	45			80	Staphylococcus equorum	5									
378	10/08/2021	21-08-0108	13	22	8.80	7.86	4.10	107			380	Staphylococcus equorum	13									
379	10/08/2021	21-08-0108	14	3207	9.66	7.17	3.96	64			20	No growth										
380	10/08/2021	21-08-0108	15	1000	6.00	6.93	4.48	42			70	Staphylococcus auricularis	5	Staphylococcus equorum	1							
381	10/08/2021	21-08-0108	16	223	5.78	5.72	4.22	45			10	No growth										
382	10/08/2021	21-08-0108	17	304	4.63	6.15	5.15	33			140	Kocuria carniphila	3	Staphylococcus auricularis	2	Staphylococcus saprophyticus	2			2	Y	
383	10/08/2021	21-08-0108	18	3010	9.83	6.90	3.99	35			50	Staphylococcus equorum	5	Corynebacterium xerosis	5	Aerococcus viridans	1				1	
384	10/08/2021	21-08-0108	19	30	6.61	6.40	4.51	41			90	Staphylococcus xylosum	1									
385	10/08/2021	21-08-0108	20	37	12.11	7.29	3.08	165			80	Staphylococcus auricularis	3	Staphylococcus auricularis	1							
386	10/08/2021	21-08-0108	21	3063	7.83	7.31	4.21	30			230	Pseudomonas sp.	1	Staphylococcus equorum	4							
387	10/08/2021	21-08-0108	22	13078	6.76	5.96	4.42	2174			1,900	Staphylococcus chromogenes	21									
388	10/08/2021	21-08-0108	23	31	8.21	7.54	4.08	200			10	Staphylococcus equorum	3									
389	10/08/2021	21-08-0108	24	3382	6.54	7.24	4.27	25			60	Acinetobacter sp.	1									
390	10/08/2021	21-08-0108	25	47	6.25	7.25	4.55	147			920	Staphylococcus equorum	16	Streptococcus luteolus	13	E. coli					1	
391	10/08/2021	21-08-0108	26	63	6.74	6.43	4.66	44			390	Staphylococcus equorum	11									
392	10/08/2021	21-08-0108	27	58	7.45	7.01	3.47	107			70	Staphylococcus auricularis	1									
393	10/08/2021	21-08-0108	28	207	6.57	6.71	4.41	101			10	Arthrobacter gandivensis	1									
394	10/08/2021	21-08-0108	29	3	10.54	8.10	3.85	68			40	Streptococcus luteolus	1	Kocuria carniphila	1							
395	10/08/2021	21-08-0108	30	41	-	-	-	-	Insufficient Sample			10	Staphylococcus xylosum	1								
396	10/08/2021	21-08-0108	31	12416	6.76	7.23	4.41	21			40	No growth										
397	10/08/2021	21-08-0108	32	8032	6.47	7.26	3.77	36			90	Staphylococcus haemolyticus	15	Staphylococcus warneri	15	Streptococcus mitis					1	Y
398	10/08/2021	21-08-0108	33	No ID Given	-	-	-	-	NO SAMPLE PRESENT													
399	10/08/2021	21-08-0108	34	757	8.92	6.75	4.10	171			50	Staphylococcus equorum	5	Erwinia persicina	1	Staphylococcus auricularis	1					1
400	10/08/2021	21-08-0108	35	12082	5.82	6.40	4.68	54			180	Staphylococcus simulans	4	Staphylococcus auricularis	4							
401	10/08/2021	21-08-0108	36	213	-	-	-	-	NO SAMPLE PRESENT													
402	10/08/2021	21-08-0108	37	No ID Given	-	-	-	-	NO SAMPLE PRESENT													
403	10/08/2021	21-08-0108	38	59	7.80	7.64	4.24	74			120	Corynebacterium xerosis	5	E. coli	3	Staphylococcus equorum					3	Y
404	10/08/2021	21-08-0108	39	12110	7.03	7.73	4.34	82			110	Staphylococcus equorum	1									
405	10/08/2021	21-08-0108	40	65	8.19	6.86	4.08	36			30	Staphylococcus chromogenes	1									
406	10/08/2021	21-08-0108	41	433	8.72	9.10	3.73	118			20	Staphylococcus equorum	5	Staphylococcus pasteurii	5	Staphylococcus epidermidis	5				5	Y
407	10/08/2021	21-08-0108	42	3680	8.40	7.36	4.40	39			50	Staphylococcus equorum	1									
408	10/08/2021	21-08-0108	43	NO TAG	10.67	7.30	3.44	430			370	Staphylococcus auricularis	21	E. coli	1	Streptococcus luteolus	1				1	
409	10/08/2021	21-08-0108	44	50	7.03	6.99	4.54	66			20	No growth										
410	10/08/2021	21-08-0108	45	Sample 1 of '3833'	9.17	6.25	3.81	148			200	Arthrobacter citreus	1	Staphylococcus equorum	1	Corynebacterium xerosis	1				1	
411	10/08/2021	21-08-0108	46	No ID Given	7.38	6.88	4.57	109			40	Staphylococcus auricularis	4									
412	10/08/2021	21-08-0108	47	48	9.40	8.32	3.90	56			20	Curtobacterium flaccumfaciens	2									
413	10/08/2021	21-08-0108	48	3019	7.18	7.51	3.51	105			450	Staphylococcus sp.	6									
414	10/08/2021	21-08-0108	49	4661	-	-	-	-	NO SAMPLE PRESENT													
415	10/08/2021	21-08-0108	50	12422	9.10	6.69	4.10	79			220	Staphylococcus equorum	3	Staphylococcus hemalis	1							
416	10/08/2021	21-08-0108	51	12124	6.79	6.05	4.41	46			50	Staphylococcus equorum	1									
417	10/08/2021	21-08-0108	52	39	7.85	6.50	4.14	97			280	Rothia amarae	8	Staphylococcus sp.	1							
418	10/08/2021	21-08-0108	53	732	6.68	6.40	4.62	68			40	Staphylococcus equorum	1									
419	10/08/2021	21-08-0108	54	12425	6.38	6.33	4.67	13			90	Staphylococcus equorum	7	E. coli	1	Streptococcus luteolus	1				1	
420	10/08/2021	21-08-0108	55	4713	6.77	6.88	4.34	81			20	Kocuria carniphila	3	Staphylococcus vitulinus	2	Aerococcus viridans					1	
421	10/08/2021	21-08-0108	56	Sample 2 of '3833'	5.92	6.69	4.42	15			20	Arthrobacter sp.	5									

Fig 10: Milk sample results 10/08/2021

1	Submittal Date	Submittal Number	Sample ID	Burr	Pre	Post	St	Compositional Analysis	Aerobic Plate Count (cfu)	Pathogen 1			Pathogen 2			Pathogen 3		
										Count	Identified	Count	Identified	Count	Identified	Count	Identified	
486	21/09/2021	21-09-0262	1	74	LOW	8.35	6.42	4.54	122	70	Arthrobacter gandawensis	4	E coli	1	Staphylococcus equorum	1		
487	21/09/2021	21-09-0262	2	No ID Given	-	-	-	-										
488	21/09/2021	21-09-0262	3	No ID Given	-	-	-	-										
489	21/09/2021	21-09-0262	4	126	LOW	7.43	7.66	3.99	146	4,500	Pseudomonas fluorescens	21	Acinetobacter guillouiae	21	Vagococcus fluvialis	21	Y	
490	21/09/2021	21-09-0262	5	No ID Given	-	-	-	-										
491	21/09/2021	21-09-0262	6	66	LOW	10.15	8.67	3.88	61	10	No growth							
492	21/09/2021	21-09-0262	7	16658	LOW	7.25	6.94	4.58	21	190	Corynebacterium lipophiloflavum	3	Staphylococcus equorum	2				
493	21/09/2021	21-09-0262	8	No ID Given	-	-	-	-										
494	21/09/2021	21-09-0262	9	231	MEDIUM	6.03	6.38	4.68	51	90	Kocuria sp.	4						
495	21/09/2021	21-09-0262	10	16611	LOW	11.51	11.33	3.01	1431	700	Corynebacterium lipophiloflavum	21	Pantoea agglomerans	2	Staphylococcus aureus	2	Y	
496	21/09/2021	21-09-0262	11	No ID Given	-	-	-	-										
497	21/09/2021	21-09-0262	12	4064	MEDIUM	8.08	8.10	3.79	125	3,600	Senatia fonticola	21	Pseudomonas sp.	21	Hafnia alvei	21	Y	
498	21/09/2021	21-09-0262	13	22	MEDIUM	11.54	9.20	3.46	109	4,300	Pantoea agglomerans	21	Staphylococcus epidermidis	21	Staphylococcus warneri	21	Y	
499	21/09/2021	21-09-0262	14	3207	HIGH	10.71	8.06	3.82	54	20	Arthrobacter gandawensis	2	Staphylococcus sp.	1				
500	21/09/2021	21-09-0262	15	1000	HIGH	9.04	7.91	4.32	38	10	Acinetobacter sp.	10	Aerococcus viridans	2	Corynebacterium lipophiloflavum	6	Y	
501	21/09/2021	21-09-0262	16	223	MEDIUM	7.64	5.88	4.32	48	360	Pseudomonas fluorescens	2	Aerococcus viridans	2	Staphylococcus equorum	2	Y	
502	21/09/2021	21-09-0262	17	204	HIGH	6.30	7.43	4.92	31	1,250	Acinetobacter johnsonii	21	Arthrobacter gandawensis	21	Delfia acidovorans	21	Y	
503	21/09/2021	21-09-0262	18	3014	LOW	16.51	8.82	3.43	59	170	Corynebacterium lipophiloflavum	21	Vagococcus fluvialis	1	Staphylococcus equorum	5	Y	
504	21/09/2021	21-09-0262	19	30	MEDIUM	8.69	7.84	4.26	53	1,010	Staphylococcus equorum	21						
505	21/09/2021	21-09-0262	20	No ID Given	-	-	-	-										
506	21/09/2021	21-09-0262	21	3063	LOW	10.34	8.16	3.71	102	20	Corynebacterium lipophiloflavum	8	Staphylococcus equorum	8				
507	21/09/2021	21-09-0262	22	12078	LOW	9.79	6.92	3.33	1524	2,400	Staphylococcus equorum	21	Acinetobacter guillouiae	11	Senatia fonticola	1		
508	21/09/2021	21-09-0262	23	No ID Given	-	-	-	-										
509	21/09/2021	21-09-0262	24	3833	HIGH	10.92	8.10	4.06	104	1,020	Enterococcus hirae	21	Arthrobacter gandawensis	21	E coli	2	Y	
510	21/09/2021	21-09-0262	25	47	MEDIUM	10.04	8.34	4.17	122	150	Moraxella sp.	1	Staphylococcus equorum	1				
511	21/09/2021	21-09-0262	26	63	MEDIUM	10.51	7.62	4.24	70	260	Staphylococcus equorum	6						
512	21/09/2021	21-09-0262	27	58	LOW	11.98	7.52	3.67	65	340	Corynebacterium lipophiloflavum	5	Staphylococcus aureus	5	Pseudomonas fluorescens	1	Y	
513	21/09/2021	21-09-0262	28	1449	HIGH	7.52	8.02	4.19	57	100	Acinetobacter guillouiae	2	Corynebacterium lipophiloflavum	2	Microbacterium lacticum	2		
514	21/09/2021	21-09-0262	29	No ID Given	-	-	-	-										
515	21/09/2021	21-09-0262	30	41	LOW	8.73	9.03	4.30	46	570	Pseudomonas fluorescens	10	Enterococcus malodoratus	2	Streptococcus parvulus	1	Y	
516	21/09/2021	21-09-0262	31	12416	MEDIUM	8.68	9.64	4.15	32	710	Corynebacterium lipophiloflavum	21	Staphylococcus equorum	1				
517	21/09/2021	21-09-0262	32	No ID Given	-	-	-	-										
518	21/09/2021	21-09-0262	33	No ID Given	-	-	-	-										
519	21/09/2021	21-09-0262	34	41	LOW	10.54	8.36	3.98	132	30	Corynebacterium lipophiloflavum	7						
520	21/09/2021	21-09-0262	35	12082	LOW	6.93	7.43	4.43	35	220	Delfia acidovorans	6	Staphylococcus equorum	6				
521	21/09/2021	21-09-0262	36	No ID Given	-	-	-	-										
522	21/09/2021	21-09-0262	37	No ID Given	-	-	-	-										
523	21/09/2021	21-09-0262	38	59	MEDIUM	10.26	9.45	3.73	118	320	Pseudomonas fluorescens	10	Staphylococcus equorum	10	Staphylococcus cohnii	1		
524	21/09/2021	21-09-0262	39	12110	LOW	9.73	10.44	3.76	93	110	Delfia acidovorans	1	Lutococcus japonicus	1	Vagococcus fluvialis	1		
525	21/09/2021	21-09-0262	40	65	MEDIUM	12.77	9.18	3.74	32	20	Pseudomonas sp.	1	Psychrobacter sp.	1	Corynebacterium lipophiloflavum	1		
526	21/09/2021	21-09-0262	41	NO TAG	MEDIUM	13.28	11.24	3.04	132	10	Acinetobacter lwoffii	1	Arthrobacter gandawensis	21				
527	21/09/2021	21-09-0262	42	3680	MEDIUM	11.95	10.17	3.65	46	40	Corynebacterium lipophiloflavum	1						
528	21/09/2021	21-09-0262	43	NO TAG	LOW	7.98	7.87	3.56	69	30	Pseudomonas fluorescens	11	Staphylococcus equorum	2	Acinetobacter guillouiae	1		
529	21/09/2021	21-09-0262	44	50	MEDIUM	9.43	7.53	4.46	35	1,900	Staphylococcus equorum	21	Kocuria camphila	21				
530	21/09/2021	21-09-0262	45	3833	HIGH	10.76	8.10	4.04	58	20	Staphylococcus sp.	1						
531	21/09/2021	21-09-0262	46	60	MEDIUM	7.05	7.25	4.69	41	490	Corynebacterium lipophiloflavum	11	Staphylococcus equorum	3				
532	21/09/2021	21-09-0262	47	48	MEDIUM	10.32	8.90	4.01	31	10	No growth							
533	21/09/2021	21-09-0262	48	3019	LOW	9.08	8.57	3.94	362	2,500	Arthrobacter gandawensis	21	Vagococcus fluvialis	21	E coli	2	Y	
534	21/09/2021	21-09-0262	49	4661	LOW	9.52	6.74	4.03	85	7,000	Staphylococcus equorum	21	Aeromonas eucrenophila	1	Senatia fonticola	1	Y	
535	21/09/2021	21-09-0262	50	12422	LOW	11.93	7.33	4.02	63	110	Corynebacterium lipophiloflavum	4	Acinetobacter sp.	2				
536	21/09/2021	21-09-0262	51	12124	LOW	8.29	6.93	4.24	43	430	Corynebacterium lipophiloflavum	21						
537	21/09/2021	21-09-0262	52	39	MEDIUM	8.65	7.29	4.34	67	260	Kocuria camphila	5						
538	21/09/2021	21-09-0262	53	732	HIGH	10.79	8.08	4.23	63	1,500	Corynebacterium xerosis	21	Kocuria palustris	21	E coli	1	Y	
539	21/09/2021	21-09-0262	54	474	HIGH	9.73	8.08	4.20	137	760	Corynebacterium lipophiloflavum	10	Staphylococcus equorum	10	Streptococcus parvulus	1	Y	
540	21/09/2021	21-09-0262	55	16565	LOW	7.56	7.56	4.39	209	800	Pseudomonas fluorescens	21	Vagococcus fluvialis	21	Staphylococcus equorum	21	Y	
541	21/09/2021	21-09-0262	56	46	HIGH	9.78	11.01	3.61	87	50	Corynebacterium lipophiloflavum	21						
542	21/09/2021	21-09-0262	57	770	HIGH	10.96	10.39	3.68	181	20	Corynebacterium lipophiloflavum	7	Kocuria marina	1				
543	21/09/2021	21-09-0262	58	NO ID	NO ID	11.98	9.87	3.45	126	1,290	Pseudomonas sp.	21	Staphylococcus equorum	21	Kocuria palustris	21	Y	
544	21/09/2021	21-09-0262	59	No ID Given	-	-	-	-										
545	21/09/2021	21-09-0262	60	No ID Given	-	-	-	-										
546	21/09/2021	21-09-0262	61	512	HIGH	7.24	6.92	4.81	272	220	Staphylococcus equorum	12	Pseudomonas fluorescens	2				
547	21/09/2021	21-09-0262	62	IWMN	HIGH	9.35	6.90	3.62	2963	3,900	Staphylococcus aureus	21	Staphylococcus equorum	21				
548	21/09/2021	21-09-0262	63	2387	HIGH	8.04	5.70	4.63	261	410	Staphylococcus equorum	2	Pseudomonas fluorescens	1				
549	21/09/2021	21-09-0262	64	0000	HIGH	15.56	9.70	3.45	2090	2,700	Pseudomonas fluorescens	21	Arthrobacter gandawensis	21	Corynebacterium lipophiloflavum	21		

Fig 12: Milk sample results 21/09/2021

1	Submittal Date	Submittal Number	Sample ID	Burr	Pre	Post	St	Compositional Analysis	Aerobic Plate Count (cfu)	Pathogen 1			Pathogen 2			Pathogen 3		
										Count	Identified	Count	Identified	Count	Identified	Count	Identified	
550	12/10/2021	21-10-0175	1	231		7.05	7.06	4.55	50	10	Staphylococcus equorum	1	Staphylococcus hominis	1	Kocuria kristinae	1	Y	
551	12/10/2021	21-10-0175	2	22		9.90	9.01	3.70	114	40	Rhizobium radiobacter	1	Staphylococcus equorum	1				
552	12/10/2021	21-10-0175	3	3207		8.58	8.35	3.83	65	10	Arthrobacter gandawensis	1						
553	12/10/2021	21-10-0175	4	1000		9.65	8.36	4.21	115	10	Staphylococcus equorum	1			</			

Of the identifiable samples, one ewe had a high SCC of over 500,000 cells/m³ eight times (12078), four ewes had a high SCC six times (16565, 16582, 16462, 16611), two ewes had a high SCC five times (74, 1000), one ewe had a high SCC three times (IWAN), two ewes had a high SCC count twice (126, 0000) and 14 ewes had one SCC above 500,000 cells/m³ (16658, 30,34,33,231,63,77,1049,757, 60, 3019, 732, 3382 and “No id” ewe). The number of high samples for each of these ewes could be higher as six samples were high in the 20/07/2021 where none of the samples were identified and some samples were insufficient for testing or not identified on various sampling dates.