Survey of Australian commercial dairy camel farms

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Abstract

Camel milk is a new, emerging market in Australia and there is limited knowledge as to what factors are needed on farm to produce a high-quality product. An electronic survey of Australian commercial dairy camel producers was undertaken to gather information on production and animal management practices. Most of the she-camels were sourced from the feral camel population in central Australia, but other sources included breeding on farm or purchasing from other farms. Herd sizes averaged 54 head of lactating she-camels and 83 dry she-camels. Milk yields averaged 5.3 L/d, lactation length ranged from 40 to 78 weeks and frequency of milking ranged from once to twice daily. The majority of the farms fed their camels native, improved grasses and grass plus legume pastures. The major health issues were mange, infectious pododermatitis and intestinal worms, with mastitis not as prevalent as the other issues. Major products were fresh milk and milk products including milk powder, cheese, chocolate and cosmetics.

Keywords: Australia, camel, milk

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Introduction

Camel milk is an emerging industry across the globe. Traditional methods are gradually advancing to intensive production systems (Nagy and Juhasz, 2016) to meet the increasing demand (Faye, 2016; Nagy, 2016) for the milk and milk products, including soft cheese, fermented milk, yogurt, ice cream and butter (Al haj and Al Kanhal, 2010). A number of intensive camel dairy farms have been established worldwide and are currently supplying both local and international markets. Over the past two decades or so there has been increasing interest in camel milk production in Western countries such as the Netherlands, Italy and USA (Faye, 2018).

Camel milk is a new and emerging market within Australia, with currently only seven commercial producers. The first license to sell fresh camel milk (in Queensland) was issued in 2006. Camel dairies are now established in Western Australia, Queensland, New South Wales, and Victoria (AgriFutures, 2016). It has been estimated that Australian camel dairies produce an average of 50,000 L/annum (Clarke, 2016).

Camels were originally introduced to Australia as transport animals in the 1840s before being released into the

outback when motor vehicles emerged. The feral population of camels grew quickly and results from aerial surveys undertaken in 2008 showed camels occupied an estimated minimum area of 3.3 million km^2 and were distributed broadly across the Australian rangelands (Saalfeld and Edwards, 2010). Initial development of camel dairy production has been largely based on sourcing of breeding she-camels from the feral herd. Trials in South Australia found that approximately 20% of mustered feral she-camels were suitable for redomestication (Virtue et al., 2016).

Generally, there has been very limited information gathered on the Australian dairy camel industry and thus the aim of this study was to identify the current status of the camel dairy farming industry in Australia and compare it to overseas markets.

Materials and Methods

A questionnaire (Appendix A) was developed for completion by Australian camel dairy farmers to collect information about their livestock production, management and farming systems. The questionnaire was approved by the Charles Sturt University's Ethics in Human Research Committee (Protocol number H19180).

Since qualitative information was mainly targeted and with some quantitative data, a survey was chosen as the appropriate tool for data collection. The use of an electronic survey (Survey Monkey) allowed respondents to maintain their anonymity. The survey consisted of a total of 70 questions and prior to release, it was trialled with the research team to make sure the questions were in an appropriate sequence.

Statistical analysis of the collected information that was categorical in nature consisted of proportions of respondents by generating percentages for each question. The numerical information collected from the survey was analysed and presented as averages and ranges.

Results

All of the seven commercial dairy camel farms in Australia were sent the questionnaire of which four responded. However, not all respondents answered all questions, and thus the number of respondents is indicated where appropriate.

Total land area

The average total size of the camel farms was 114.25 ha and ranged from 43 to 194 ha. Seventy five percent of respondents dedicated over 80% of their land to fodder production and the remaining 25% of respondents dedicated only 20% or less of their land to fodder production for the camels. The average land area for irrigated fodder production was 60 ha, with a range of 20 ha to 150 ha.

Farm staffing

On average, the respondents had been milking camels for 4.25 years, with a range of 2 to 5 years. The average labour force per farm was 5.25 man units, with a range of 1 to 7 man units. The average number of hours the farm staff (including owners and managers) worked was 32.25 h/week with a range of 20 to 38 h/week.

Herd size

The average and range of herd sizes for the various classes of camels is presented in Table 1. The camels had been sourced as either feral animals from the desert (for subsequent redomestication) and/or bred on-farm or purchased from other (camel) farms. The selection criteria for the she-camels included good temperament, and appropriate udder and teat size and overall conformation.

Table 1. Herd sizes (average and range) of Australian dairy camel farms (n=3)

Class	Average	Range
Milking she-camels	54	8 - 110
Dry she-camels	83	30 - 130
Heifers	40	23 - 60
Heifer calves	19	1 - 35
Bull calves	21	14 - 25
Bulls	3	1 - 4
Steers	4	0 – 10

The newly introduced feral camels were firstly halter-broken and then slowly introduced to the milking parlour by following already domesticated she-camels. This procedure was undertaken both before and after calving. After calving the she-camels were retained in the milking parlour with their calves next to them as the milking machine was introduced. The animals were regularly handled during the redomestication process to get them used to human contact. On average, this domestication (training) process took 61.6 h, with a range of 5 to 90 h.

Male camel calves were sold domestically for either transport, tourism, racing or (domestic) organic farms for weed control. One farm sold some of their male calves to international buyers.

Milk production

The average and range of milk yields, frequency of milking, time of peak lactation and lactation length of the machine-milked she-camels are presented in Table 2. The number of animals that could be milked at once ranged from of 1 to 8. Of the survey respondents, 75% spent 1-2 h per milking process (time to milk the herd, either once or twice daily), the remaining 25% of respondents spent 2-3 h per milking process.

Table 2. Milk production, milking frequency, peak lactation and lactation length of she-camels on Australian dairy camel farms

Parameter	Average	Range
Average daily milk yield (L/d; n=3)	5.3	5 - 6
Average lactation length (weeks; n=2)	59	40 - 78
Time of peak lactation (weeks, n=1)	6	-
Frequency of milking (times/d; n=4)	1.5	1 - 2

Feeds and supplements

Native, improved grass and improved grass plus legume pastures were the base feeds provided to the camels on all of the farms. On two of the surveyed farms the camels also grazed annual pastures and were fed conserved fodders. None of the camels were fed pellets but on one of the farms their camels were fed grain. Mineral supplements were provided to the she-camels and calves on all of the farms and on two of the farms vitamin supplements were also given.

The amount of feed provided to animals varied between farms and classes of livestock. The average amount of feed (as fed) provided to the milking she-camels was 13 kg/hd/d, with a range of 10 to 19 kg. The average amount of feed provided to the dry she-camels was 11 kg/hd/d, with a range of 5 to 20 kg/hd/d.

The amount of solid (excluding milk) feed provided to the camel calves varied, from limited access to full access (exact amounts were not specified). On all farms the camel calves were provided access to hay within a few weeks of being born.

She-camel and calf management

Two of the farms used year-round calving, and one utilised seasonal calving. For all of these farms natural mating was used, with the number of bulls ranging from 1 to 4 per farm.

The average annual mortality rate of calves was 8%, with a range of 4% to 10%.

There was variability in the length of time the calf and she-camel remained together after milking, ranging from 1 h to 2-3 h to 6 h. On all of the farms, weaning of the calves did not occur until after they were 12 months of age.

Camel health

On two of the farms the she-camels were vaccinated, although no information was provided with respect to what the disease(s) this vaccination was for. The major health issues identified were Se deficiency, mange, infectious pododermatitis, intestinal worms and, to a lesser extent, mastitis. The treatments utilised for these conditions included Se injection (for known Se deficiency), apple cider vinegar and garlic (for mange and infectious pododermatitis) and drenching (for worms). Treatments for mastitis included antibiotics, vitamin C supplementation and putting the she-camel and calf in a paddock away from the dairy parlour until the clinical signs subsided.

Milk processing and marketing

All of survey respondents processed their camel milk on-farm for sale as fresh milk and for further processing (off-farm) of milk products (which included milk powder, cosmetics, cheese and chocolate). Two of the producers sold some or all of these products to countries including USA, Singapore, Malaysia, Thailand, China, Hong Kong, New Zealand and Canada.

Discussion

To our knowledge, this was the first comprehensive survey involving Australian commercial camel dairy farmers. In general, the survey respondents were small enterprises, with the average number of milking she-camels being 54 with the range of 8-110. This is much lower than in traditional camel-milking countries (Mehta et al., 2009; Abdullah and Faye, 2013).

Milk yield

With improved husbandry, it has been suggested that daily maximum production of she-camels could reach 35 to 40 L (Faye, 2018). In this study, only data on average rather than peak lactation yield was collected. The average daily yield (5.3 L/d) and range (5 L/d to 6 L/d) were similar to those reported by Nagy and Juhasz (2016) (5.8 kg/d to 6.9 kg/d) and Jemmali et al. (2016) (6.72 ± 2.46 L/d) under intensive systems but higher than the yields of 3.24 L/d to 5.39 L/d reported by Zeleke (2007) and Reta and Mekonnen (2002). It should be noted; however, these lower yields were from hand milked camels, whereas Australian dairy camel farmers machine milk, which typically yields higher quantities than hand milking (Bakheit et al., 2008; Hammadi et al., 2010). In addition, frequently the estimated quantity of milk consumed by the calf is added to the daily yield (Nagy and Juhasz 2016), which was not the case in this study, and would contribute to the variability in milk yields reported in the literature.

Milking frequency varied among Australian producers and this would have also impacted on average daily yields. Abdalla et al. (2016) found milk secretion rate decreased linearly with increasing milking interval (from 4 h to 24 h).

Lactation length

Many factors affect camel milk yield including stage of lactation (Zeleke, 2007; Al-Saiady et al., 2012) and lactation length (Musaad et al., 2013). Information was provided by only one respondent on the timing of peak lactation (at six weeks), which was much earlier than the fourth to fifth month reported by Nagy and Juhazs (2016) and the 9 to 19 weeks reported by Bekele et al. (2002). Further investigation of the timing and milk production at peak lactation in Australian she-camels is recommended.

The average lactation length was 59 weeks (approx. 14 months), which was within the wide range (6-19 months) reported within the literature (Bekele et al., 2002; Kakar and Muhammad, 2008; Mussaad et al., 2013). However, it was longer than reported by Babiker and El-Zubeir (2014) for intensive farms in Sudan (9-10 months). The variations in lactation lengths likely reflect differences in management systems, breeds, dairy potential and pregnancy status of the camels between countries

Feeds and feeding

Nutrition may also have contributed to variation in milk yields. Not only did the amount of feed provided to the she-camels vary, but also the types of basal feeds and

supplements provided. Information on the nutritive value of the diets (pastures and supplements) fed to the she-camels would enable determination of the impacts of diet on milk yields. However, it can be assumed the lactating she-camels would have been consuming a medium to high quality diet.

The level of inclusion of concentrates affects not only milk yield but also milk components (Kashongwe et al., 2017). Only one of the farm fed concentrate (grain), and whether providing a higher energy diet to the she-camels would impact milk yields requires further investigation. The she-camels were not provided with protein supplements. Dereje and Uden (2005) found supplementing oil seed by-products with relatively high crude protein value, such as groundnut cake, had a substantial positive effect on milk production in camels. The basal pastures available for grazing by the she-camels would have been relatively high in protein (compared to dry mature pastures and straws). Mineral supplements were provided, but examples of specific supplements were not provided. Selenium deficiency was highlighted as an issue; however, supplementation (injection) was routinely undertaken and therefore was unlikely to have contributed to the variation in milk yields between farms.

Selection of animals

The data generated from the survey did not enable determination of what were the major factors affecting milk yields of Australian she-camels, and warrants further research. It is likely that genetics was a major contributing factor to the relatively poor milk yields compared to some other countries. Genetic improvement for milk productivity in dairy camels is slow due to their long life-span and limited knowledge of the heritability of specific dairy traits. Al-Mutairi et al. (2010) reported moderate heritability of 0.24 and 0.22 and annual genetic progress of 0.05 and 0.0003 kg for 305 d milk yield and for test day yield over a 23-year period, respectively. It is reasonable to expect relatively slow genetic improvement in productivity of Australian dairy camels, especially given that increase in herd sizes is still based predominantly on redomestication of feral animals, and not the selection and breeding of superior animals.

The selection of she-camels; however, extends beyond their production potential, with Australian dairy camel farmers also selecting animals on appropriate udder and teat size and overall conformation. These were similar selection criteria as reported by Alhadrami and Faye (2016).

Temperament was an important selection criteria, especially given that the majority of the farms were utilising feral animals as a source of she-camels. However, these feral animals were historically from domesticated camels that were released into the Australian outback (wild) in the 1840s. The common techniques used for redomestication of these animals included halter-training and then gradual introduction to the milking parlour. There was considerable variation (5 h to 90 h) in the time for redomestication (training) to be completed, which was likely a reflection of different training protocols and/or variation in the temperament of the animals. Despite the variability, the redomestication process would be considered relatively fast and was likely because the camels available would be from the 20% of mustered feral camels deemed suitable for redomestication (Virtue et al., 2016).

Calf management

The number of calves produced ranged from 20 to 40 to more than 60; however, it was not

possible to determine calving rates which would have been more useful when comparing to data reported by other researchers. Further, information on reproduction rates (conception, birth and weaning rates) and mean calving intervals would provide more useful information on the reproductive success of Australian dairy camels and allow comparison with international, intensive dairy camel systems.

Nursing calves were left with their mothers for a period of 1 to 6 h after milking and then reunited prior to the next milking so they could suckle and stimulate milk letdown. Hussen et al. (2008) reported this method was typically performed on Ethiopia camel farms. This separation method allowed for a high milk yield from the she-camels in the diary parlour, while still producing enough milk for calves. However, in other intensive production systems, the calf is not used for stimulating milk letdown, with camels either manually pre-stimulated or trained for machine stimulation (Nagy and Juhasz 2016).

The average annual mortality rate of calves was 8%, with a range of 4% to 10% (although cause of death was not reported). These rates were very low compared to traditional systems, with calf mortality rates of 27.3%, 22.3% and 31.4% reported for Rendille, Gabra and Somalia, respectively (Kaufmann, 2000), with disease found to be a main cause of these losses (Keskes et al., 2013). Ahmadpour et al. (2018) found that in pastoral (extensive) systems, low colostrum intake was the core cause for high mortality rate of the camel calves. Increased knowledge of improved animal husbandry including colostrum feeding and ready access to veterinary services would contribute to improved calf survival rates on Australia dairy camel farms.

Consideration will need to be given to disposal of male calves with any future expansion of the Australian dairy camel industry, as there is the potential that existing markets could become saturated. Development of a camel meat industry (Zeng and Gerritsen, 2013) could be a potential market for the male calves.

Animal health

The major health issues identified were mange, infectious pododermatitis and intestinal worms, with mastitis of a lesser issue. Currently, there are no antibiotics registered for camelids in Australia (M. Bale, Chief Veterinary Officer, Australian Wild Camel Corporation, pers. comm.) and thus are only administered off-label. Throughout the world, mastitis treatment is still based mainly on antibiotics but in some countries, traditional preventative and treatment methods and other non-antibiotic treatments are also used (Iyer et al., 2014; Ali et al., 2018). These non-antibiotic treatments include herbal remedies (Kalayou et al., 2012). Some of the Australian dairy camel producers were utilising antibiotics (off-label) while others used non-antibiotic treatments for mastitis, but the effectiveness of these treatments needs further verification. Further, data were not collected with regards to the specific incidence of mastitis and warrants further research.

Mange (presumably sarcoptic mange) was another health issue and has been previously identified as a serious health issue in camels (presumably feral) in Australia (PISC 2006). Studies from different parts of the world (Agab and Abbas, 1999; Dinka et al., 2010; Sazmand and Joachim, 2017) indicate the prevalence of mange in camel populations range from 3.5% to 83% (Zahid et al., 2015). Apple cider vinegar and garlic were the treatment options utilised by Australian

producers. Factors contributing the mange infestations of domesticated camels and the efficacy of these treatments requires further investigation.

Infectious pododermatitis (colloquially referred to as foot rot by the survey respondents) was highlighted as another health issue, but whether this had been clinically diagnosed cannot be determined. The soft tissues of the camel's foot may predispose them to several issues including sore feet, abscess, sole ulcers (Ramadan et al., 1986) as well as grain founder (Sharma and Sharma, 2006). Further research is warranted to better understand the cause of pododermatitis in Australian dairy camels.

In extensive production systems, the diet of camels consists mainly of herbs, shrubs and woody plants, with forage from woody plants overall constituting a higher proportion of the diet (Leparmarai et al., 2018). Browse was not provided to any of the camels on the farms and worms were identified as a health issue. There is the potential that change in diet (to no longer include browse as would be normal component for feral camels) may have contributed to this problem. Many browse species contain condensed tannins and previous studies with a range of tannin-containing forages have demonstrated anthelmintic effects (Brunet et al., 2008; Mengistu et al., 2017). Investigation of the effects of inclusion of browse in the diet on worm burdens in Australian dairy camels would provide a greater understanding of the effects of condensed tannins in camel and may ultimately reduce the need for drenching.

Selenium supplementation was common practice. In Australia, Se deficiency in sheep and cattle is a serious problem in all States particularly in regions of high rainfall (>500 mm annually) (Judson and McFarlane, 1998). Selenium is likely equally important in camel nutrition. Previous studies from the UAE (where soils and feedstuffs are generally considered deficiency in Se) found Se deficiency during pregnancy and lactation were the cause of calf deaths (Faye et al., 2014). It is important; however, that Se is not over-supplemented. Seboussi et al. (2008) highlighted that for camels the sensitivity to excess Se intake was at lower levels than in cattle, and identified the maximal tolerable dose was 8 mg and recommended doses ranges from 2 to 4 mg. Specific details of the dose rates used by Australian dairy camel farmers were not provided.

Milk processing and marketing

All of the survey respondents processed their camel milk on-farm for sale as fresh milk or for further processing as milk products, which included milk powder, cheese, chocolate and cosmetics. Data relating specifically to whether the products were manufactured on site was not collected, although it can be assumed that given the relatively small size of these enterprises it was likely the products were processed through contract manufacturing.

Many other countries including Kazakhstan, UAE, Morocco, India, Saudi Arabia, Algeria, Mauritania and Egypt also produce these products. Globally, these products are becoming more common in response to an increase in consumer's knowledge of the industry and also the modernisation of the camel milk processing technologies (Konuspayeva and Faye, 2018). However, there are still issues to be resolved with regards to camel milk products. These difficulties in making products from camel milk have occurred due largely to the unique structural and functional properties of the milk components. These difficulties are because of the long coagulation time from a

greater number of casein micelles and weak curd formation (Al haj and Al Kanhal, 2010). The difficulty in obtaining a coagulum with camel milk is due to its low concentration in k-casein which is responsible for clotting and for curd quality. The concentration is around 3% in camel vs 13% in cow milk (Kappeler et al., 2003). However, camel milk can be processed into cheese using camel chymosin (Wang et al., 2015; Hailu et al., 2016) and the addition of starter cultures for acidification (Bekele et al., 2019).

Yoghurt and ice cream were not being made by Australian producers. This may have been due to production difficulties. Production of yoghurt from camel milk using the same procedure as for cow milk yoghurt is difficult (Galeboe et al., 2018) and has poor sensory profiles if made without adding gelling additives. In addition, it has a higher susceptibility to syneresis than cow milk yoghurt (Ibrahim and Khalifa, 2015). Jafarpour (2017) compared ice creams made from either cow milk or camel milk and found that while there was no significant difference between fat and protein contents, solid matters content viscosity and melting point of cow milk ice cream were higher than those of camel milk ice cream. Sensory tests also did not show any significant difference among samples. Thus, manufacture and competition of an ice cream made from camel milk is feasible and a potential opportunity for Australian dairy camel milk producers.

Conclusion

With camel milk only entering the domestic consumer market over the past few years, there is still limited knowledge as to what factors are needed in order for the farms to produce a consistent high-quality product. Due to prevailing droughts and the trend towards decreasing dairy cow production, the camel has gained more attention as a way of bridging the gap between demand and supply. To progress the Australian camel dairy industry and to become a significant competitor on the international market requires research in many areas including nutrition, milking efficiency, identification of superior animals, reproductive technologies and milk processing technologies. It would be beneficial to repeat a similar study in a few years' time to see the changes in the industry and identify the progresses and the further developments needed in this sector.

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Appendix A: Questionnaire

Section A: General Information

1. In which state or territory of Australia2. is your camel dairy located?
2. How many years have you been farming camels for dairy purposes?
3. What is the total area of your camel dairy farm (in hectares)?
4. What area (ha) of your farm is devoted to producing fodder for your camels?
5. What area (ha) of your fodder production land is irrigated?
6. How many staff do you employ on your camel dairy farm?
7. On average, how many hours in total do the staff work each week? (Total hours worked by all paid staff per week)
8. How many times a day do you milk the camel cows?
    a. Once
    b. Twice
    c. Three times
    d. Other (please specify)
9. In your dairy parlour, how many milking machines are utilised during the camel milking process?
10. How many camel cows can be held in the dairy parlour race ready for milking?
11. On average, how long does your farm's milking process take?
    a. Less than 1 hour
    b. 1-2 hours
    c. 2-3 hours
    d. More than 3 hours

Milk processing and products

12. For manufacturing, where is the camel milk processed?
    a. On farm
    b. Commercial business off site
13. What is the distance (in km) from the farm to the milk processing centre?
14. Which of the following products does your camel dairy farm sell commercially?
    a. Fresh milk
    b. Milk powder
    c. Cheese
    d. Yoghurt
    e. Ice cream
    f. Chocolate
    g. Cosmetics
    h. Other (please specify)
15. What proportion (%) of your total camel dairy farm income is derived from these products? (Please estimate a % for each product or enter '0' if none)
    a. Fresh milk
    b. Milk powder
    c. Cheese
    d. Yoghurt
    e. Ice cream
    f. Chocolate
    g. Cosmetics
    h. Other

Fresh milk

16. What was the average price ($ per litre) you sold your fresh milk for over the past 12 months in the following categories?
    a. Distribution
    b. Wholesale
    c. Retail sale
    d. Export sale
    e. Direct orders
17. Do you plan to expand your dairy farm in the future?
    a. Yes
    b. No
18. Do you export (internationally) any of your camel dairy-based products?
    a. Yes
    b. No
19. To which country or countries do you export your camel dairy products?
20. Do you live export (internationally) any of your camels?
    a. Yes
    b. No

Section B: Farm livestock and production

21. How many head of the following categories of camel livestock do you currently have on your farm?
    a. Milking cows
    b. Dry cows
    c. Heifers
    d. Heifer calves
    e. Bull calves
    f. Bulls
    g. Steers
22. How many of the following categories of camel livestock were purchased in the past 12 months?
    a. Milking cows
    b. Dry cows
    c. Heifers
    d. Heifer calves
    e. Bulls
23. How many head of the following categories of camel livestock were sold in the past 12 months?
    a. Milking cows
    b. Dry cows
    c. Heifers
    d. Heifer calves
    e. Bull calves
    f. Bulls
    g. Steers
24. Where do you source your dairy camels from? (Please select all that apply)
    a. Caught from the desert
    b. Purchased from other farms
    c. Bred on farm

25. Do you train your own camel cows for dairy purposes?
    a. Yes
    b. No
26. How long (in hours), on average, does it take to train the camel cows for dairy purposes?
27. Please describe briefly how you introduce your camel cows to the dairy practices:
28. Please list the major traits that your farm looks for in a typical 'good' dairy camel cow:
29. What is the average lactation length for you camel cows (in weeks)?
30. What is the average daily yield per camel cow for your milking herd (in litres)?
31. What is the average milk yield (in litres) over the entire lactation period for the milking herd?
32. At what stage (weeks) does peak lactation occur?

Section C: Herd management and health

33. Does your camel dairy farm maintain up to date herd management records?
    a. Yes
    b. No
34. Do you use any farm management software or apps for your camel dairy farm (e.g., dairy comp Alta, Milk manager app, Mistro, dairy live)?
    a. Yes
    b. No
35. Which farm management software and/or apps do you use for your camel dairy farm?
36. What herd and/or farm management method do you use for your camel dairy farm?
37. Are vaccinations a regular practice for your herd?
    a. Yes
    b. No
38. Are your camel cows vaccinated during the dry period?
    a. Yes
    b. No
39. Does a veterinarian regularly assess the health of your camels?
    a. Yes
    b. No
40. How often does a veterinarian visit to assess camel health?
    a. More than once a month
    b. Once a month
    c. Every 2-3 months
    d. Twice a year
    e. Annually
    f. When there is a problem
41. Do you have any incidence of mastitis in your milking herd?
    a. Yes
    b. No
42. What technique do you use the treat the inflammation/infection?
43. Have you tested the camel cows for which strain of mastitis they have?
    a. Yes
    b. No
    c. Please indicate which strain/s:

44. What other camel health issues are important on your farm?
45. What treatment/s have been used to treat those camel health issues?

Section D: Calf management

46. On average, how many camel calves are produced on your farm per year?
    a. None
    b. Less than 20
    c. 20-40
    d. 41-60
    e. More than 60
47. What calving system is used on your dairy farm?
    a. All year round
    b. Seasonal
    c. Other (please specify)
48. During which month/s is the main calving period for your camel herd?
49. How long are the calves left on the cows before being fully weaned?
    a. Less than 12 months
    b. More than 12 months
50. After milking, how long do you keep the camel calves and cows together?
    a. No time
    b. Up to 1 hour
    c. 1-2 hours
    d. 2-3 hours
    e. Other (please specify)
51. How do you separate the cows and calves between milkings?
52. At what age, in weeks, are the calves introduced to solid feed?
53. What solid feeds are given to the calves? (Please select all that apply)
    a. Hay
    b. Straw
    c. Grain
    d. Pellets
    e. Other (please specify)
54. What supplements are given to the calves? (Please select all that apply)
    a. No supplements
    b. Probiotics
    c. Vitamins
    d. Mineral supplements
    e. Other (please specify)
55. Based on the total number of calves born per year, what is the average camel calf mortality rate (%)?
56. What is done with male camel calves after they have been weaned? (Please select all that apply)
    a. Sold domestically for meat and/or leather
    b. Sold domestically for breeding
    c. Sold domestically for transport and/or tourism and/or racing
    d. Sold internationally for meat and/or leather
    e. Sold internationally for breeding
    f. Sold internationally for transport and/or tourism and/or racing
    g. Other (please specify)

Section E: Feed management

57. Which of the following feeds are available or given to the camels on your farm? (Please select all that apply)
    a. Native pasture
    b. Improved grass pasture
    c. Improve grass and legume pasture
    d. Annual fodder
    e. Browse
    f. Conserved doffer
    g. Grains
    h. Pellets
    i. Other (please specify)
58. How many kg of feed per animal per day does your farm provide to the following?
    a. Dry cows
    b. Milking cows
    c. Calves
59. Are any commercially sourced feeds certified as organic?
    a. Yes
    b. No
60. What supplements are given to the camel cows?
    a. No supplements
    b. Probiotics
    c. Vitamins
    d. Minerals
    e. Other (please specify)
61. Is a qualified animal nutritionist and/or agronomist consulted regarding feed and supplements?
    a. Yes
    b. No

Section F: Colostrum feeding

62. Is the quality of colostrum monitored on your farm?
    a. Yes
    b. No
63. How is the quality of colostrum measured?
    a. Clostrometer
    b. Brix refractometer
    c. Visual observation
    d. Other (please specify)
64. On average, what is the quality of the colostrum?
    a. High
    b. Medium
    c. Low
    d. Don't know
65. Does your farm store surplus colostrum?
    a. Yes
    b. No

66. Do you keep the stored colostrum frozen?
    a. Yes
    b. No
67. How long does the colostrum last frozen?
68. How is the colostrum stored?

Section G: Final comments

69. What are the three main problems with day to day management of your camel dairy?
70. If you have any further comments about this survey or about camel dairy farming, please enter these below: