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ABSTRACTS

#1 Differential ileal amino acid digestibility of sheep and cow milk in a rat model

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Sheep milk is a rich source of vitamins, minerals and energy, with up to 50% more milk solids than cow milk. Anecdotally, sheep milk is also thought to be better tolerated than cow milk and some of these affects have been attributed to differences in sheep and cow milk protein digestibility. However, controlled scientific studies examining this aspect have not been done. Therefore, we fed raw sheep milk or raw cow milk to newly weaned Sprague-Dawley rats as a model for human nutrition and examined the difference in apparent ileal amino acid digestibility. Over a 28 day period, male Sprague-Dawley rats were fed a dairy-free rodent chow and provided raw sheep or cow milk, which was their only source of water. During this time, the rats were also housed individually in metabolism cages at days 12-14 and 26-28, at which time the rats only had access to the sheep or cow milk. There were no significant differences in mean body weight after 28 days of milk feeding. However, milk and solid food consumption differed between the groups. Rats fed the raw cow's milk consumed more solid food than rats that were fed raw sheep milk but there was no difference in intake volume of sheep or cow milk. Amino acid digestibility in the distal ileum after the final period in metabolism cages (days 26-28) was higher in rats fed sheep milk; amino acid intake in sheep milk rats was 1.8 times higher, but the ileal content amino acid concentration was only 1.3 time higher. Differences in amino acid digestibility were reflected in serum amino acid concentrations which could be clearly differentiated based on the type of milk consumed. Concentrations of essential amino acids in the serum were significantly higher in rats fed sheep milk. Our results suggest sheep milk proteins are more readily digested than cow milk proteins in vivo and this difference is reflected in a higher bioavailability of essential amino acids. The observation that the rats fed sheep milk required less solid food than rats given raw cow milk to maintain the same level of growth also supports the view that sheep milk is an excellent source of nutrition.

#2 The effect of milk consumption on vital organ mineral levels in rats

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Milk is an excellent source of minerals that play an important role in human health. Milk from various species may have differential advantages in delivering minerals to organs. The present study investigated whether consumed sheep and cow milks affect mineral concentrations in liver, brain, kidney and spleen of rats. Newly weaned male rats were fed ad libitum for 28 days one of the milks and a dairy-free rodent chow. There were no differences in growth irrespective of treatment. The concentrations of 42 minerals were determined in the organs and the milks by ICPMS. Rats fed whole sheep milk consumed significantly less ($p<0.05$) chow than those feed cow milk. The average daily intake of ten minerals was significantly higher ($p<0.05$) for rats fed whole sheep milk than for rats fed cow milk. No significant differences in the concentration of nutritional minerals tested were found in organ tissues due to treatment ($P>0.05$). For non-nutritional minerals, rubidium and caesium were elevated in rats fed sheep milk compared to rats fed cow milk ($P<0.05$). Consumption of high mineral content from sheep milk did not lead to mineral accumulation in the body.

#4 Protein polymorphism – a sheep milk investigation

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Polymorphism is the occurrence of different protein morphological forms in the proteome of a species. A polymorphism that persists over many generations is usually maintained because no one form of the protein possesses an overall advantage in terms of natural selection. However, genetic polymorphism of milk proteins from ruminants has been strongly associated with quantitative and qualitative milk parameters (e.g. yield, curd formation). Therefore, breeders should consider the milk protein profile to select for a protein composition suitable for their production specification. Investigating the protein profile of New Zealand sheep milk provides the opportunity to examine the genetic diversity in the present-day sheep milk stock. Milk samples from individual sheep from different producers were collected throughout the 2015-2016 lactation season. The protein compositions were analysed using liquid chromatography and were further investigated using mass spectrometry and 2D gel chromatography. The results of these analyses provide insight into the genetic diversity of milking sheep in New Zealand, with the consequent potential to use this information for breeding purposes.

#5 Nitrogen and the dairy sheep industry

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One of the biggest challenges facing food producers today is managing and reducing the environmental impacts of their farming activities. The emerging dairy sheep industry in New Zealand, with its perceived lower environmental footprint, will also be subjected to the same scrutiny in the future. A key aspect of determining the environmental impact of an industry is understanding how nitrogen (N) flows through the farming system. Under pastoral grazing by sheep or cattle the conversion efficiency of dietary N into animal products, such as milk, meat or wool, is typically less than 25% of the total N intake, meaning that the majority of the ingested N is excreted as either urine or dung. While the environmental impact of sheep farming for meat is generally lower than for dairy farming, the actual impact of dairy sheep farming has not been assessed. A desktop study was undertaken that reviewed current literature (both published and unpublished) to gain an understanding of the N balance for dairy sheep, with particular emphasis on sheep grazing of mainly pasture-based diets. The review of the mainly European published data found that the average retention of dietary N for sheep was 12%. The amount of dietary N excreted as dung was between 27% v 32% while urine was between 61% v 56%; the proportion in urine being higher as dietary protein content of feed increased. For comparison dairy cows have been found to excrete 26% of dietary N as dung, 53% as urine, 17% as milk and retain 4%. The aim of this presentation is to provide an overview of our current understanding of the nitrogen cycle and flows within the dairy sheep industry and to indicate where further research is required to improve our ability to model the environmental impacts of this new dairying system.

#6 Does feeding meal affect growth of artificially reared East Friesian-cross dairy lambs?

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In large-scale dairy farms, a large number of lambs is produced every year, and in some systems, these lambs are artificially reared with unlimited milk replacer (MR) and meal. The aim was to compare the effect of including or excluding meal from lambs' diets on growth over weaning transitions. Sixty lambs were divided into groups of either meal feeding (M) or no meal feeding (NM). Lambs were fed unlimited MR, and meal (M only), initially indoors (wk 0-3; period 1), then on unrestricted pasture (wk 4-5; period 2). Lambs were then weaned from MR, but meal continued to be fed to M lambs until week 10 (wk. 6-10; period 3). All lambs were then maintained on pasture until the experiment ended (wk 10-12; period 4). While there was a weight gain advantage in M lambs in periods 1 and 3, these lambs experienced a growth check following meal weaning compared to NM lambs. By week 12, there was no different in live weight (~24 kg) between the two groups. The results indicate that a rearing system without meal feeding can be used to grow lambs to 12 weeks when feeding unrestricted good-quality pasture.

#7 Effect of weaning age on ruminal fermentation profiles of artificially reared lambs

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We investigated the effect of weaning age on rumen fermentation profiles of lambs to develop artificial management options for commercial farming practices Thirty-two lambs (mixed-sex) were randomly assigned to one of the weaning groups: early-weaning (4wk) and control (6wk). Milk replacer (200 g/L; 24% CP and 25% fat) was offered at 20% of initial body weight and weaned using a three week step-down procedure in each group. Concentrate and chopped meadow hay were offered ad libitum in individual feeders from week one to six. At the end of week six, lambs were moved onto a ryegrass-based pasture. Half of the lambs from each weaning group were slaughtered at the end of week four and sixteen, respectively. Rumen contents were collected to determine pH, short chain fatty acids (SCFA) and ammonia (NH4) concentrations. Results of NH4 showed 2.3 times greater (P=0.05) concentration in EW than Ctrl lambs at week four, but these did not differ between groups at week sixteen. Weaning age did not affect the SCFA profiles and pH at either week four or sixteen. These results suggest that ruminal fermentation can be established in lambs by four weeks using a step-down weaning method with early access to starter diets.

#8 Rumination and feeding behaviour of artificially reared dairy lambs with or without early access to meal

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Artificially rearing lambs is commonly performed on large-scale dairy farms. The provision of unlimited milk replacer (MR) access and early access to a grain-based meal is used to help stimulate rumen development to support earlier weaning. However, the potential to substitute meal with early access to pasture before weaning has not been reported for artificially reared lambs. We hypothesised that lambs given access to meal before weaning would initiate rumination earlier and spend more time grazing than lambs without access to meal due to earlier rumen development. The results of this study indicate that lambs without meal access had a later onset of rumination, but were able to smoothly transition on to pasture, spending more time grazing and ruminating by the end of the trial than lambs offered early access to meal. These findings may help in providing alternative rearing practices for artificially reared lambs.

#9 The impact of stocking density on lamb growth

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The New Zealand dairy sheep industry aims for a 100% utilisation of all offspring born into the system. To achieve this, artificial indoor rearing systems are often used. These rearing systems tend to use a period of indoor housing in group pens followed by transition to outdoor environments. For dairy ewes housed indoors, stocking density has been found to impact aspects of health, production and welfare. Limited data on the impact of stocking density for artificially-reared dairy sheep lambs is available. The aim of this study was to evaluate the impact of two different stocking densities ($0.45m^2$ vs. $0.8m^2$ per lamb) on lamb growth in the first 3 weeks of indoor rearing. Preliminary results from this study indicate that lambs housed indoors at lower stocking density have higher rates of growth than lambs at higher stocking density in the first week of rearing but not thereafter. Ongoing evaluations include the impact of stocking density on additional health and welfare characteristics and subsequent performance after transition to outdoor environments.

#10 The impact of different housing systems on dairy ewe health and production

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The New Zealand dairy sheep industry is rapidly expanding, so research is underway to determine farming systems to optimise ewe milk production and composition. This research will contribute to the development of optimised farming systems for dairy sheep, especially with the drive to import new genetics that may not be well-adapted to the NZ pastoral system. During my Masters, my focus is on understanding how different management systems influence dairy ewe health and production: 100% indoors on a total mixed ration diet (TMR); indoors during the day with a TMR diet and grazed on pasture overnight; indoors during the day with a TMR diet and grazed on lucerne overnight; and 100% grazed on pasture outside. The impact of these systems on energetic outputs will be assessed using remote technologies, notably GPS collars to monitor walking distance and Hobos to monitor standing/lying behaviour. Weather stations and humidity devices will also be used to monitor the climatic environment. Combining these parameters with ewe health and productivity traits (e.g. body condition score, live weight, disease incidence, and milk production) will provide insight into the best management strategies for farmers to get the optimal performance from their dairy ewe flock.

#11 Effect of sheep and cow milk and yoghurt drinks on gastro transit in a rat model

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Fermented dairy products such as yogurt are known by consumers for their ease of digestion and health benefits. This is largely attributed to a combined action of the beneficial bacteria used for the fermentation together with the release of components from the food matrix including bioactive peptides released from milk proteins during fermentation. Due to the differences in protein composition between species we hypothesized that sheep milk would produce different bioactive peptides and thus different gastrointestinal (GI) motility from cow milk. We therefore compared the effect of fermentation of cow and sheep milk on the rate of GI transit of solid contents in a rat model. This was achieved by feeding the rats sheep or cow milk or yogurt and monitoring the movement of beads from the stomach to the large intestine over 12 hours by high resolution X-ray imaging. The results show that stomach emptying in animals fed with sheep yogurt drink was 5-fold faster than that for cow yogurt drink. Fermentation of cow milk produced a gradual enhancement of stomach emptying over 9 hours. Overall GI transit was 18% faster for sheep milk than for cow milk ($p<0.05$). Colonic transit was increased by 2.3-fold for sheep milk compared with cow milk, suggesting that it would reduce constipation. Our findings demonstrate prominent species differences between the milk drinks and between the yogurt drinks. The increased stomach emptying and colonic transit by sheep milk compared with cow milk would be expected to improve gut comfort, reduce constipation, and generally improve a sluggish gut.

#12 Heat Stability of Sheep Milk Whey as a Base Ingredient in Foods/Beverages

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A major waste stream from sheep cheese manufacture is whey, which is primarily used as animal feed. Conversion of this stream to a more profitable product is desirable. It is likely that potential products for whey will be liquid-based, e.g., beverages or soup stocks. To comply with food safety regulations such a product will need to be heat treated. This project investigated the impact of key manufacturing variables (whey/curd separation pH, and salt concentration) on the stability (assessed by sediment levels) of whey when heat treated at 90°C/5 min at pH 3.5 and pH 4.5. Both laboratory-produced whey streams and commercially manufactured whey streams were investigated. The main findings were that all whey samples were unstable on heating at pH 4.5, resulting in a large volume of sediment (13 to 40%). In contrast, whey samples heated at pH 3.5 were generally very stable (<0.5% sediment). The exception to stability at pH 3.5 was when salt was added to the whey (either to the cheese milk before curd formation and separation or after curd separation). Addition of salt up to 5.8 g/L of added Na resulted in stable whey, however addition of ≥8.8 g/L Na resulted in sediment volumes of >40%. These results show that sheep whey could be processed into a stable base ingredient for beverages or soup stocks under controlled pH, salt and heat treatment.

#14 Development of a portable milking platform for ovine dairy

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Despite the potential profitability of ovine dairy, the large cost of specialised milking infrastructure limits conversion of existing farmland. A portable milking platform could provide a temporary solution for farmers considering a partial or incremental conversion to ovine dairy. An existing mobile milking trailer can milk 16 ewes simultaneously, requiring only a single operator. The current project will critically assess the existing trailer and develop a redesign that decreases downtime, increases milk extraction rate, and meets the relevant food safety standards and farming best practice. Secondary improvements will increase the production capacity of the system. The theory of inventive problem solving (TIPS - sometimes known as TRIZ) is a formal engineering design methodology and will be used to guide the redesign. TIPS provides objective insight to innovation by abstract identification of the problems in the current design and solving the identified problems based on prior art, logic, data and research rather than intuition. This presentation will outline the commercial efficacy of the mobile plant, the current trailer function and the planned innovation.

#20 Effects of energy and protein intake on pre-weaning lamb growth

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Under pastoral conditions, nutrient intake from both milk and pasture is contributing to lamb growth. In grazing ewes, milk production up to day 42 of lactation accounted only for 36 % to 49 % of the variation in lamb's growth rate during the same period [1] To get a better understanding on how nutrients supply from milk and forage controls early lamb growth, three experiments with lambs reared artificially indoors were conducted. For lambs between 4 and 18 kg live weight (LW) the following requirements were estimated: ME for maintenance = 0.40 MJ/kg LW0.75; ME for growth = 13.8 MJ/kg LWGain, CP for maintenance = 2.74 g/kg LW0.75; CP for growth = 228 g/kg LWGain. Based on those values it can be calculated that the optimal CP:ME ratio for maximal growth is higher at the 4 kg LW and decreased curvilinearly [2]. However, under normal milk and forage intake condition this ratio is low at the start and increased linearly, thus going in the opposite direction of the optimal ratio. Lamb fed a milk replacer with a high CP:ME had higher protein deposition rate and lower lipid deposition rate than those fed a normal milk replacer.[1] Danso et al. 2016, J.Anim.Sci. 94: 5359–5371 ; [2] Danso et al. 2016, J.Anim. Sci. 94:3527–3539

#21 Collecting and managing test-day data: benefits and challenges

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The reason to record is to find the animals that convert forage most efficiently, for the longest period, with minimal amount of labour input into a high value concentrated food source for human consumption, i.e., fewer sheep, equals less time in the yards, milking shed, and less cost per unit of production. By using a set of key questions ,practical data collection can be set up: What is your objective? How do you plan to get there? What must you record to get there? In this case the object was maximise dollar return per hectare. The plan being as follows; Feeding first – Get the high energy feed to the ewes for longer, Breeding second – Get the ewes that put the energy into milk in the vat, not fat on the back. Third, labour costs down - less sheep per production unit, less time in the milking shed, better/faster let down. It was found in the first season of data recording, through culling decisions a 9% reduction in ewe numbers and a 15% increase in per animal performance was achieved. In the second season of recording and assessment results show that udder manipulation in the milking shed may be influencing let down of milk negatively.

#22 Mastitis in ewes

SW Peterson, BA Nieper, M Collett, A Grinberg
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Little mastitis research has been reported in New Zealand sheep. Because "hard udder" was observed in 5% of ewes in lactation trials, udders and teats of 1824 Romney hill-country ewes were examined from one month after weaning. Suspected mastitis was palpated in 5% of ewes, but hard udder was not conclusively identified in any. Perhaps different kinds of mastitis can be detected at different stages of lactation. Post-mortem samples collected from 41 sheep revealed 11 had Staphylococcus aureus, two had Trueperella pyogenes (Arcanobacterium pyogenes) and 22 had mixed bacterial growth, suggesting that mastitis in suckler sheep is not similar to bovine mastitis and that the pathogenesis may be linked to bacteria in soil or in lambs' mouths. These preliminary results are in line with reports from overseas studies of dairy sheep, but further research is needed to determine the incidence and pathogenesis of various types of mastitis in suckler ewes and its effects on sheep production. No research has been reported in dairy sheep in New Zealand; incidence and effects of both subclinical and clinical mastitis in dairy sheep should be investigated since an overseas report indicates losses of up to 50% of milk due to subclinical mastitis.

#23 The effect of sildenafil citrate administration during pregnancy on vasculature and parenchymal structure of the involuting mammary gland of ewes

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When sildenafil citrate (SC) was administered during late pregnancy to increase fetal growth in triplet-bearing ewes, extensive mammary tissue growth was observed. This study examined the hypothesis that SC increased mammary parenchymal development through increased tissue vasculature. Mammary tissue samples were collected after weaning of lambs, five months after treatment ended. Mammary glands from SC-treated ewes were 200 g heavier than those of controls and SC-treated ewes had more mammary epithelial cells (MEC) than did controls ($P=0.09$). Mammary gland weight was positively correlated with the mean area of individual MEC, luminal area of alveoli and total alveolar area ($P<0.05$). SC treatment did not alter mammary vasculature. Although this study demonstrates that treatment with SC during late pregnancy does not cause permanent alterations in mammary vasculature, when measured during mammary gland involution, parenchymal area was increased due to a combination of more MEC present in the mammary gland, as well as greater alveolar area. These novel observations may be highly relevant to discovering ways to improve milk production in small ruminants.

#24 Research Opportunity - Life Cycle Assessment (LCA) of Sheep

R Mohan
Massey University

Is NZ sheep dairying more environmentally benign than cow or goat dairying? How would we know? Life cycle analysis (LCA) is a methodology for determining the environmental footprint of an industry. To date, LCAs have been done on a variety of NZ agricultural industries, and overseas on sheep dairy case studies. This presentation proposes a comparative LCA of NZ sheep dairying at farm scale with a view to demonstrating the industry's relative environmental impact. An LCA for a dairy sheep farming system can also provide a better understanding of farm energy requirements and potential areas for cost reduction. The proposed research project will be jointly supervised by Massey University's School of Management and the School of Engineering and Advanced Technology (SEAT).

#29 Estimating breeding values in dairy sheep using genomic relationships

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We describe the use of a genomic relationship matrix and daily measures of milk yield to estimate genomic breeding values in a dairy sheep flock with no pedigree information. A Legendre polynomial model was fitted to over 400 data points from 1300 ewes to estimate milk production curves over the lactation for each ewe. Heritability of milk yield was estimated at 0.3 from the data. Genomic information was also used to estimate relatedness between individuals, inbreeding coefficients and proportion of dairy genetics as well as a breeding value for each ewe and predicted values for offspring and related animals without phenotypes. The model clearly showed that there is significant variation amongst animals in the shape of the lactation curve and we recommend that for prediction in the current NZ flock, at least monthly measures should be recorded. Low cost genotyping tools are available to the dairy sheep industry and provide opportunity for rapid, well managed genetic gain.

#30 How SIL could be used Dairy Sheep genetic selection

A O'Connell
Beef and Lamb NZ

SIL is part of BLNZ Genetics New Zealand, funded partly from sheep meat levies, and partly from fees charged to breeders. With significant recent 'under the hood' investment and improvements to the database, SIL is in a strong position to provide genetic tools support of the sheep, beef and deer industry. In response to interest from sheep milking entities, BLNZ Genetics is looking to develop a sheep milking module for data storage and routine genetic evaluation for generation of eBVs for sheep milking industry. Animals with pedigree and performance information would be ranked within flock for their milk production ability (and other favourable traits). Standard sire summaries and selection lists would be generated to support breeding and culling decisions within flock. For entities which choose to share rams and genetic information, across flock evaluations ranking animals in the industry would be possible. This would support choices for selecting outside sires and assessing genetic progress of individual flocks relative to industry average. SIL has a long history of working with stud breeders and respecting the individual breeder's commercial IP. The decision to share or not share data remains wholly with the breeding entity at all times.

#31 Establishment and genetic improvement of Dairymeade breed

R Morris
Massey University

In 2016 Dairymeade was officially established as the first milking sheep breed developed in New Zealand. Commencing in 1996, a breeding program using East Friesian sheep with initial infusion of Coopworth and Border Leicester has been carried out continuously to create a dairy sheep ideally suited to milking under New Zealand conditions. Quantitative performance measures have progressively been implemented, and 5000 animals are now recorded in the breed database, from which heritability estimates and breeding values of animals have been statistically determined. This provides a method for improving the national milking sheep flock.

#32 Genetic evaluation of dairy sheep: a prototype model

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A prototype genetic evaluation of milk traits, live weight, somatic cell score, and litter size at birth was developed for a dairy sheep flock in New Zealand. The analysis was carried out on 123 crossbred ewes with a mixture of East Friesian, Highlander, Polled-Dorset and Poltex breeds. Lactation yields were derived using a random regression model with an orthogonal polynomial of 3rd order for fat and lactose daily yields, and an orthogonal polynomial of 4th order for milk and protein daily yields. Genetic parameters and breeding values were estimated by restricted maximum likelihood (REML) using a multi-trait animal model. Genetic parameters were obtained from values published in literature with heritability estimates of 0.13 for lactation length, 0.27, 0.21, 0.24 and 0.27 for milk, fat, protein and lactose yield, respectively, 0.65 for LWT, 0.09 for SCS, 0.42 and 0.38 for FLDT and FLDY, respectively, and 0.11 for LS. Phenotypic standard deviations were obtained from the data set using the linear model that included the fixed effect of lactation number and deviation from median lambing date of the flock. When estimates of genotypic and phenotypic correlations were not found in literature, the genetic correlations were assumed to be equal to phenotypic correlations obtained from the data set.

#33 A prototype economic index for selection of dairy sheep

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A prototype economic index was developed for the selection of dairy sheep, to ensure that genetic change will occur in the right direction, in the right proportion. The analysis was carried out on 123 crossbred ewes with a mixture of East Friesian, Highlander, Polled-Dorset and Poltex breeds. The economic values (EV) of each trait were derived from desired relative economic weights (REW), following the methods of VanRaden (2002) and Komlósi et al. (2010). Relative economic weights decided by the farmers personal preference were 5% for lactation length (LL), 30%, 3%, 3% for milk fat and protein yield, 3% for live weight (LWT), 15% for somatic cell score (SCS), 15% and 20% for first let-down time (FLDT) and first let-down yield (FLDY), and 6% for litter size (LS). Random methodology was used to calculate the corresponding economic weights according to the REWs desired by the famer and genetic standard deviations of the traits. The economic values were $0.516/day for LL, $2.00/kg milk, $6.73/kg fat, $8.37/kg protein, -$0.81/kg LWT, -$46.80/unit of SCS, -$1.80/s of FLDT, $332.30/kg FLDY and $44.00/lamb of LS. It is recommended that the farmers use this index for the ranking of ewes and rams to be selected as parents of the next generation. Thus, achieve genetic gain, as well as producing progeny with improved milk yield, milk quality, milking speed and overall efficiency.

#34 Halal social financing of sheep dairy farming & industry'

B Husain
Awqaf NZ

Awqaf (Endowments) New Zealand has been the world leader in developing a new Social financing tool to establish large-scale farms specifically to supply livestock to humanitarian large-scale annual industry. After years of research and development, it became clear that sheep dairy farms are the best option to meet our objectives. The presentation will show how Islamic Social Finance via the Islamic Capital Market can raise capital at zero interest rate to establish large-scale sheep dairy farms. Also we aim to make the industry aware of new financing tools and new market that could help speed the growth of the sheep dairy industry in New Zealand and internationally. Recently we present our model in Alberta, Canada. We are now working to prepare a pre-feasibility study to establish a pilot project of two sheep milk farms in New Zealand and Alberta, Canada.