Houston: we have a conference

Rachel Hebditch reports from the 2011 International Conference on Camelid Genetics and Reproductive Biotechnologies, and on the following pages we have features on three of the topics covered

THE 2011 INTERNATIONAL CONFERENCE on Camelid Genetics and Reproductive Biotechnologies was held in Houston, Texas on September 16-18. It was organised by the Alpaca Registry Inc and the Alpaca Research Foundation and follows on from the successful First International Workshop on Camelid Genetics held in 2008 which brought together scientists and veterinarians interested in camelid research. Feedback from the first gathering indicated that alpaca owners and breeders were interested in attending this type of event and so the Houston conference was opened up.

As Abe Rosebloom, president of the ARF put it; "The First International Conference was so successful in getting scientific investigators together and generating cooperative research that it is necessary to bring them together again, along with a host of others who can add still more to our fund of knowledge. This time we are able to invite camelid breeders as well as scientists and to educate those breeders, utilising those people who actually do the work. As a result, the average alpaca owner can now reside at the cutting edge of camelid genetic and reproductive research and come away with knowledge that might not otherwise be available for months or even years."

He went on to thank two scientists who made significant contributions to the gathering, Dr Warren Johnson of the National Cancer Institute and Dr Ahmed Tibary of Washington State University who you may recall was the keynote speaker at the British Alpaca Futurity.

The conference was held at the Westin Galleria which is a large hotel with an even larger shopping mall attached. The Americans made us work hard. Breakfast started at 7am, the Opening Comments from Shauna R Brummet were at 7.40 and then we were into it with short breaks for coffee and lunch. Each day there were several plenary sessions and then we split for Breeder Breakout or Researcher Breakout lectures. The speakers came from Canada, Chile, Italy, Peru, Australia, Austria, Oman, Dubai, Morocco and the USA.

Topics covered included Alpaca Genome Mapping, Genetics of Infertility, Chromosone mapping, Suri Genetics, Colour Genetics, Candidate Genes for Choanal Atresia, Genetics of Viruses Affecting Camelids such as Corona Virus and BVDV and in Reproductive Technology, Ovulation Inducing Factor, Embryo Transfer, In vitro fertilisation and Cloning, the Role of EPD's in Genetic Improvement, the Costs, Benefits and Risks of Assisted Reproduction.

Dr Belinda Appleton earned a PhD in genetics at Melbourne University in 2002. She has broad research experience in evolutionary biology and molecular biology and her research has included analyses of native fauna including bats, marine invertebrates and commercially important fisheries. Her interest in agriculture and approaches from the industry led to a change in direction to the study of alpacas and in particular fleece related traits.

A second lecture by Dr Andew Merriwether was an overview of ongoing and future research into the genetic mechanisms and inheritance patterns of the suri phenotype in camelids. Most research has pointed to a single gene or to two very tightly linked genes close together on the same chromosome that are almost always transmitted together. Current studies by Merriwether (Binghamton University), Appleton (University of Melbourne), Gutierrez (Universidad Complutense de Madrid) and Renieri (University of Pisa) were discussed. The outcome of the suri genetics research is that a PCR-based genetic test for suri homozygosity/heterozygosity will likely become available in the future.

a handle on

suri

By **Dr Belinda Appleton**

APPROACHES FROM A GROUP of Australian breeders led to the formation of Alpaca Genomics Australia and the inception of this project. These breeders were hoping we could find a test for suri so they could tell from birth whether a male was worth keeping. This would save both time and money. We have moved from a world without any alpaca specific genetic tools to a world with a radiation hybrid library and where a 10X public sequence is imminent (**10X public sequence** is the new improved version of the alpaca genome sequence that will be publically available).

Our early genetic mapping with traditional microsatellite markers has provided information on the genetic location of suri while the newer technologies of genome wide SNP genotyping and the whole genome sequencing of six animals have provided further focus on Suri,

There are many factors by which we may judge a fleece – factors such as density, diameter, lustre, crimp, rate of growth will be controlled by many genes

There are many factors by which we may judge a fleece. Factors such as density, diameter, lustre, crimp, rate of growth will be controlled by many genes. I have focused on the fundamental difference between huacaya and suri - the structure of the fibre. Work in other species has implicated many genes in the production of hair/wool (Purvis and Franklin 2005). The epidermal growth factor-EGF [Moore et al. 1985; Mann et al. 1993], Tumor necrosis factor-TNF (Srivastava et al. 1997; Laurikkala et al 2002), (wingless/int)-WNT (Millar et al. 1999; Kishiomto et al. 2000) , sonic hedgehog signaling-SHH (St-Jacques et al. 1998), and Bone morphgenetic protein-BMP (Kulessa et al. 2000; Botchkarev et al. 2001) pathways are all thought to assist in the regulation of hair follicle formation and activity. Each of these pathways can include many genes. In all of these pathways there are genes that turn on and off, genes that modulate expression of other genes and then there are the genes that create the structural proteins required to make the hair. As you can see there are many candidates for the gene that creates the suri trait and as such we began with optimism but not a conviction that we would actually find the gene.

For some time the suri trait has been thought to be inherited as a single gene, with the suri phenotype dominant. Every alpaca has two copies of all of their genetic information. A dominant trait means that only one copy is required to produce that trait.

Our analysis of the pedigree information in the Australian Alpaca Association database found very few unexplained examples of unexpected fleece type in small families. However there has been a recent publication (Presciuttini et al 2010) that suggests that Suri could be produced from the action of two genes that are very close together. This would provide the opportunity for some small number of unexpected phenotypes in offspring. However it is important to remember that in all livestock, low levels of unexpected results can often be explained by mis-identification of parents. Sometimes animals do not behave

as we would like! This can only be ruled out by parentage testing. Unexpected results may also be due to the fact that many of the sires are not homozygous suri males. The removal of huacaya offspring alone is not enough to effectively fix the suri alleles- even in a single gene scenario. Without a test to determine whether they are heterozygous or homozygous, we are making assumptions. Regardless of the inheritance we want to find the genetic location. This would allow us to develop a test that could assist breeders.

Assuming a single gene dominant inheritance, then crosses with suri parents will result in a minimum of 50% suri offspring- but many of the offspring produced will be heterozygous. This is problematic for suri breeders as they are keen to know which of the males they have are homozygous for stud purposes.

The best way to progeny test a suri male is to mate with huacaya females. Calculations show that you would need to mate him with (and produce offspring) with 10 huacaya females- and all of these crosses/matings would have to produce suri progeny to be 99% sure that the male is homozygous suri.

Breeders may not want to breed to huacayas, but the alternative is to mate the suri male with suri females and would require 24-60 matings all resulting in suri progeny – to be 99% sure he is homozygous suri. The variation from 24-60 suri females depends on the ratio of homozygous or heterozygous females. Homozygous females should not be used for these tests as when crossed with a suri male (even a heterozygous suri male) all offspring will be suri. However it is difficult to know whether a female is homozygous or heterozygous as they do not produce offspring quickly enough or even enough offspring in their lifetime to be sure. So the more homozygous suri females you have in the mix, the more matings it will take before you can

The more homozygous suri females you have in the mix, the more matings it will take before you can be sure of the male's genotype

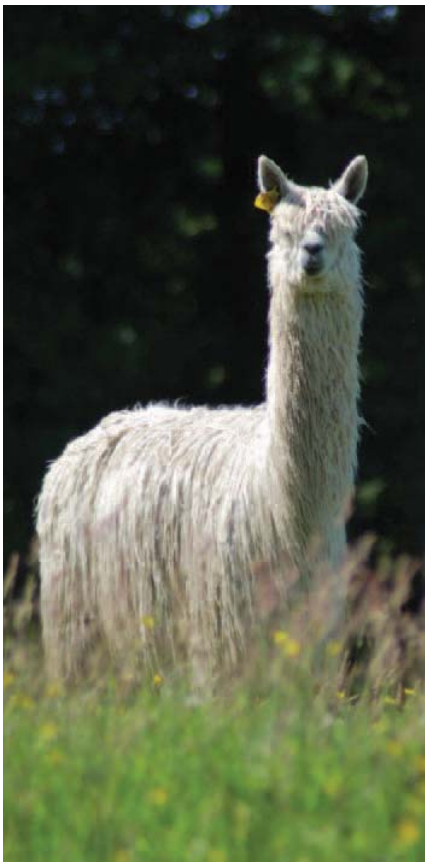
be sure of the male's genotype. It is valuable to remember that as the proportion of suris in the population increase and as you get more homozygous suris- it becomes more and more difficult to remove the last few heterozygotes from the population, especially if they are female.

In order to find the genetic region that contained the suri gene we began with a pedigree design. We began with the largest possible family headed by a heterozygous suri sire. This heterozygous suri sire had over 500 descendents and about 250 individuals that were informative to our question. We wanted to trace the suri allele originating from the original heterozygous suri sire and to ensure that no other suri alleles crept into the family that would confuse the signal. Therefore we selected offspring from our heterozygous sire that were produced from huacaya females. On selecting this family, we then approached animal owners and requested a blood sample from each animal. We were very lucky that our suri breeders have been so accommodating to our requests for samples. Numbers in the family were reduced as some animals had died, while others had been sold off as pets or sheep guards and their breeders had lost track of them. After all of our searching we ended up with 140 individuals in our pedigree. All blood samples were collected from animals by a vet specializing in alpaca.

Considering alpacas have 37 chromosome pairs, we were not expecting to find anything quickly. We initially genotyped 56 microsats in our family and were lucky to find two markers that showed linkage to the trait within our family. So we focused in on the region. We used the alpaca, the human and bovine genome sequences to find and design more microsats and we have now found over 30 markers in the region – all of which are linked in the family and are positively associated with the trait.

We have recently sequenced the genomes of six Australian alpacas to assist in our research. We are currently searching these data for more information and we are looking at more microsatellites to help us narrow in on the correct location.

We hope that in the near future we will have a test that will assist suri breeders everywhere, and ideally have a better understanding of the genetic basis to the trait.



REFERENCES

Botchkarev et al. (2001) *Noggin is required for induction of the hair follicle growth phase in postnatal skin.* FASEB J. 15 2205 – 2214.

Kishiomto et al. (2000) *Wnt signaling maintains the hair-inducing activity of the dermal papilla.* Genes Dev. 14 1181-1185.

Kulessa et al. (2000) *Inhibition of Bmp signaling affects growth and differentiation in the anagen hair follicle.* EMBO J. 19 6664 – 6674.

Laurikkala et al. (2002) *Regulation of hair follicle development by the TNF signal ectodysplasin and its receptor Edar. Development* 129 2541 – 2553.

Mann et al. (1993) *Mice with a null mutation of the TGF-a gene have abnormal skin architecture, wavy hair and curly whiskers and often develop corneal inflammation*, Cell 73 249 – 261.

Millar et al. (1999) *WNT signaling in the control of hair growth and Structure.* Dev. Biol. 207 133 – 149.

Moore et al. (1985) *Pattern and morphogenesis in skin.* J. Theor. Biol. 191 87 – 94.

Presciuttini et al (2010) *Fleece variation in alpaca (Vicugna pacos): a two-locus model for the Suri/ Huacaya phenotype.* BMC Genetics 11 70.

St-Jacques et al. (1998) *Sonic hedgehog signaling is essential for hair development.* Curr. Biol. 8 1058 – 1068.

Srivastava et al. (1997) *The Tabby phenotype is caused by mutation in a mouse homologue of the EDA gene that reveals novel mouse and human exons and encodes a protein (ectodysplasin-A) with collagenous domains.* Proc. Natl. Acad. Sci. USA 94 13069 – 13074

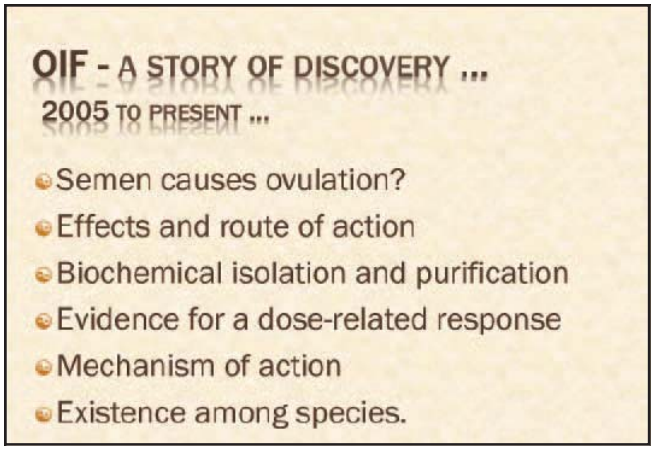
ovulation-inducing factor in seminal plasma

Or what makes alpacas ovulate? It turns out that it is not the act of mating or the orgling but something in the seminal plasma.

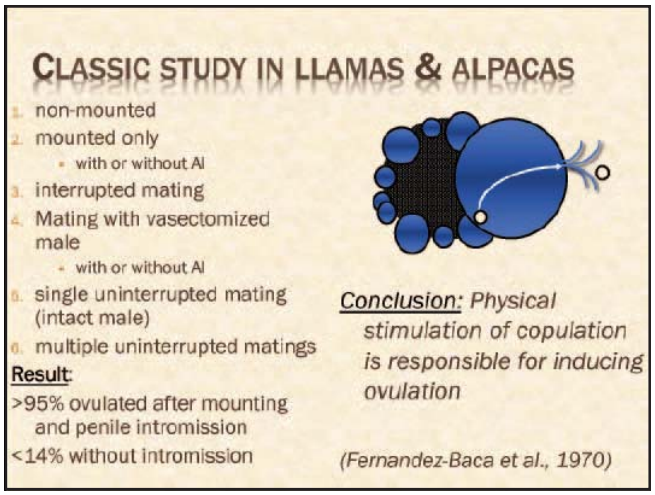
Dr Gregg Adams is presently Professor in the Department of Veterinary Biomedical Sciences at the University of Saskatchewan and a recipient of the Distinguished Researcher Award, the highest honour for research bestowed by the university. He has published classic studies of ovarian follicle development, ovulation and fertility in many species including cattle, llamas, alpacas, musk oxen, wapiti and humans.

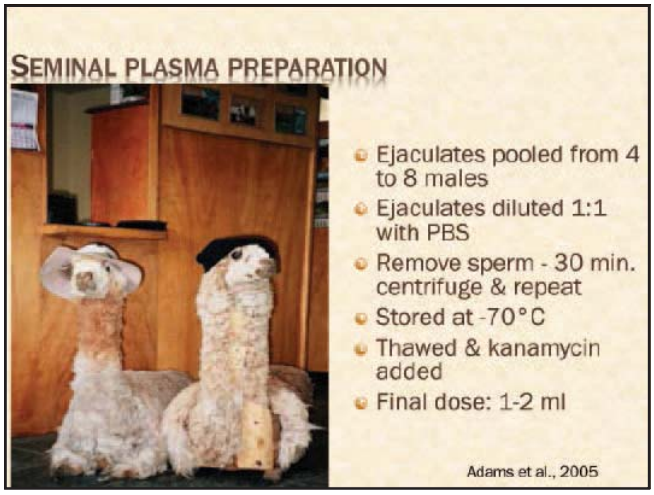
This review is offered about what is known about OIF (ovulation inducing factor) in seminal plasma and its co-author is **Dr Marcelo H. Ratto** of the Faculty of Veterinary Sciences at the Universidad Austral de Chile.

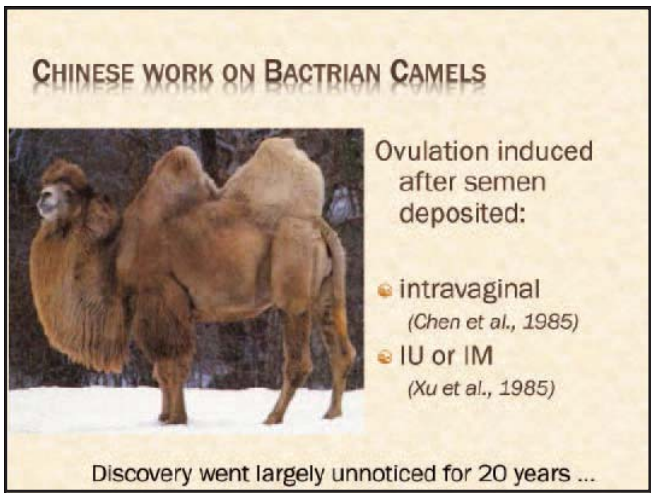
IN 1970 A CLASSIC STUDY in llamas and alpacas concluded that the physical stimulation of copulation is responsible for inducing ovulation. Meanwhile in a largely unnoticed paper by B.X. Chen, Z.X. Yuen and G.W. Yen in 1985 the researchers found that ovulation in Bactrian camels was induced by seminal plasma, even after storage at low temperatures, and that spermatozoa alone were not effective in inducing ovulation. There was also unpublished data that showed that intramuscular injection of camel semen resulted in ovulation and that bull semen also seemed to contain OIF. In 1994 Julio Sumar reported that intravaginal deposition of alpaca semen resulted in ovulation of six out of ten alpacas and five out of eight llamas.

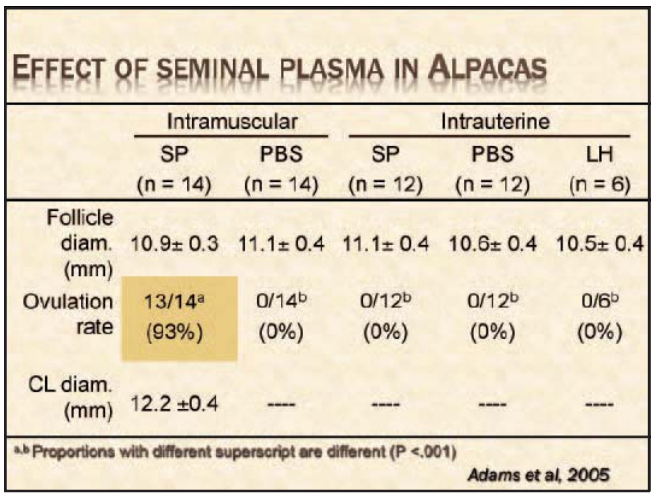


In 2005 Ratto, Huanca, Singh and Gregg Adams published a paper that concluded that OIF in seminal plasma effects ovulation via a systemic rather than a local route which supported the hypothesis that a chemical substance in the semen is responsible. None of the controls who were treated with saline (PBS) ovulated.









There was a big difference in ovulation in alpacas between seminal plasma administered with an IM injection (93%) and those who were given it intrauterine (41%). This is thought to be because in normal mating there is an acute but short lived inflammation of the endometrium, the lining of the womb, which probably facilitates absorption of OIF, so when the researchers used intrauterine curettage the rate went up to 67%.

SYSTEMIC (IM) VS LOCAL (IU) MODE OF ACTION

	Intramuscular		Intrauterine		Intrauterine curettage	
	SP (n=15)	PBS (n=15)	SP (n=17)	PBS (n=15)	SP (n=15)	PBS (n=15)
Follicle diam (mm)	8.0±0.3	8.2±0.3	8.1±0.3	8.0±0.3	8.3±0.2	8.4±0.3
Ovulation Rate (%)	14/15[a] (93%)	0/15[c] (0%)	7/17[b] (41%)	0/15[c] (0%)	10/15[ab] (67%)	0/15[c] (0%)
CL diam (mm)	9.3±0.4	----	9.5±0.3	----	9.4±0.4	----

[a,b,c] Proportions are different (P < 0.01)

Ratto et al, 2005

SO ... DOES OIF EXIST?

	Intramuscular		Intrauterine		Intrauterine with curettage	
Ovulation rate in:	Seminal plasma	Saline	Seminal plasma	Saline	Seminal plasma	Saline
Alpacas (Adams et al., 2005 – OIF)	13/14[a] (93%)	0/14[b] (0%)	0/12[b] (0%)	0/12[b] (0%)	–	–
Alpacas (Ratto et al., 2005)	14/15[a] (93%)	0/15[c] (0%)	7/17[b] (41%)	0/15[c] (0%)	10/15[ab] (67%)	0/15[c] (0%)
Llamas (Adams et al., 2005 – OIF)	6/6[a] (100%)	0/6[b] (0%)	–	–	–	–
Total	33/35[a] (94%)	0/35[d] (0%)	7/29[b] (24%)	0/27[d] (0%)	10/15[c] (67%)	0/15[d] (0%)

The researchers concluded that OIF does exist and might be an evolutionary asset and subject to natural selection and that it probably exists in other species. The next stage was to compare the ovulatory effect on seminal plasma of different species.

The conclusion was that OIF is present in seminal plasma of all species tested so far including induced ovulators like alpacas and llamas and spontaneous ovulators like mice.

INTERSPECIES EFFECT (ON FEMALE LLAMAS)

	saline (n=19)	Seminal Plasma: Llama (n=19)	Seminal Plasma: Alpaca (n=19)	Seminal Plasma: Bull (n=19)
Follicle diameter (mm)	10.0±0.7	8.9±0.3	9.0±0.3	8.7±0.2
Ovulation rate (%)	0/19[a] (0%)	19/19[b] (100%)	19/19[b] (100%)	5/19[c] (26%)
CL diameter (mm)	----	10.4±0.4	10.1±0.3	9.6±0.7

[a,b,c] Proportion are different (P < 0.01)

Ratto, et al, 2006

But what is OIF?

CONCLUSIONS SO FAR ...

- OIF is conserved among species
  - present in seminal plasma of all species tested so far
  - OIF in seminal plasma induces ovulation in both induced ovulators (alpacas & llamas) and spontaneous ovulators (mice, others?)

The next experiment was to find out whether ovulation is affected by the amount of OIF and whether the dose is relevant to the amount in a normal ejaculate. It is.

MATERIALS AND METHODS

- 50 female llamas (n= 10 per group)
- Treated IM with:
  - PBS (negative control)
  - Purified OIF*: 500 µg, 250 µg, 125 µg, 60 µg

*Doses = 1/25th to 1/200th of normal ejaculate

Tanco et al., 2011

DOSE-EFFECT OF OIF ON OVULATION

	PBS (n=10)	60 µg (n=10)	125 µg (n=10)	250 µg (n=10)	500 µg (n=10)
Follicle size at the time of treatment (mm)*	10.6±0.6	10.6±0.3	9.0±0.2	9.1±0.2	10.5±0.1
Ovulation rate (%)	0/10[a] (0)	3/10[a] (30)	7/10[b] (70)	9/10[b] (90)	9/10[b] (90)

*No difference among groups (P = 0.3)

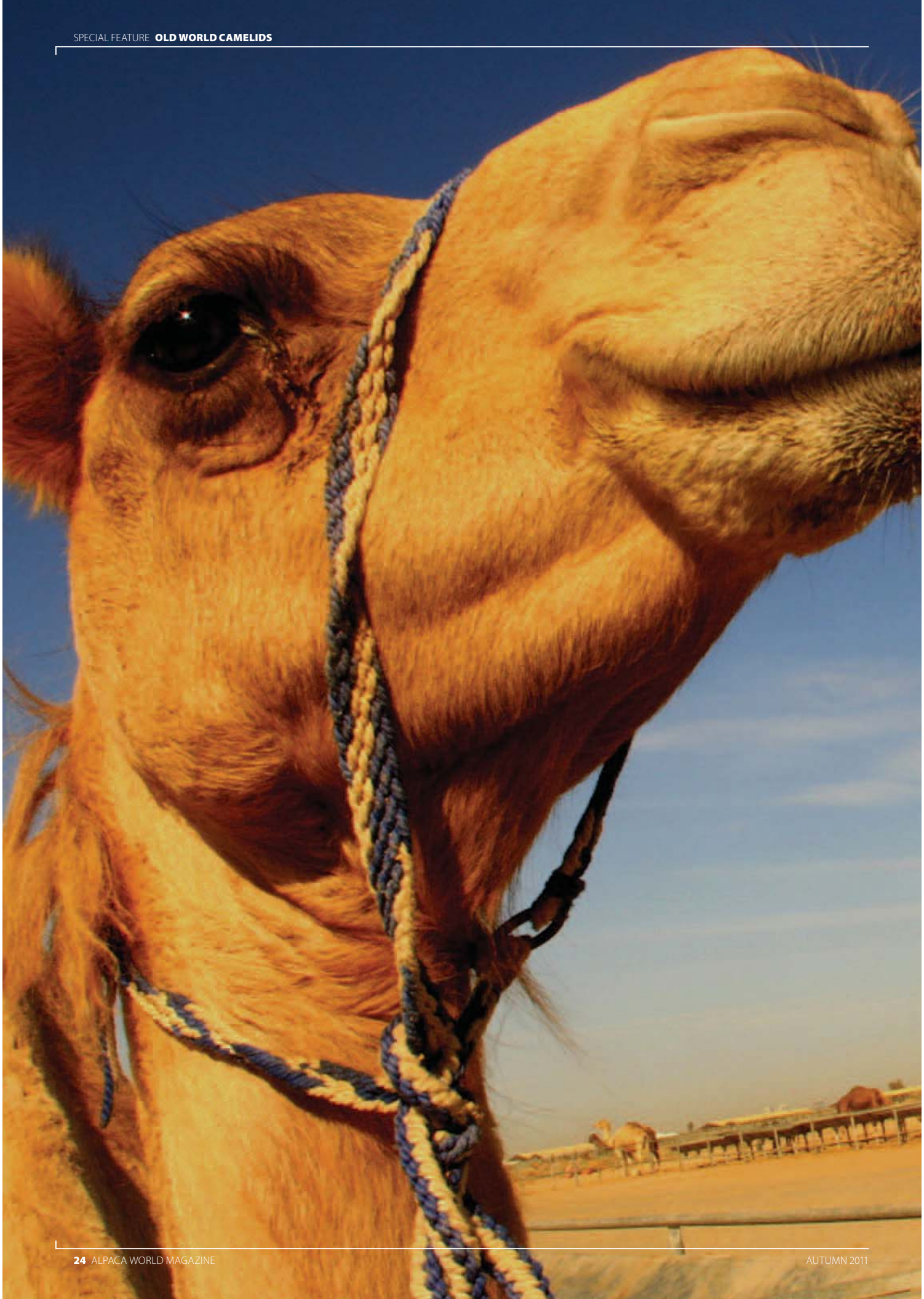
[a,b] Proportions with different superscripts are different (P <0.05)

Tanco et al., 2011

In conclusion OIF does exist, is a 14kDa protein and further research could lead to a better understanding of its role in ovulation and infertility.

OIF - WHERE WILL THIS LEAD ...?

- Peptide sequence of OIF
- Is OIF conserved among all mammals?
  - Llama/alpaca excellent biological model to evaluate OIF
- Tools to identify and measure OIF
- Tissue sources & targets
- What is role of OIF in spontaneous ovulators?
- What is role of OIF in infertility?



Houston Conference 2011

camelicious!

Intensive camel farming, mechanised milking, camel milk chocolate, strawberry flavoured camel milk, frothy camelcinos are the result of an ambitious project deep in the Dubai desert. We uncover innovative projects for old world camelids.

Photos: Alicia Sully

THE DELEGATES AT THE HOUSTON CONFERENCE were promised a piece of camel milk chocolate, shaped like a camel of course, and tasting, well, like chocolate, if they survived Dr Peter Nagy's lectures on embryo transfer in camels and the use of ovarian synchronisation protocols to improve pregnancy rates.

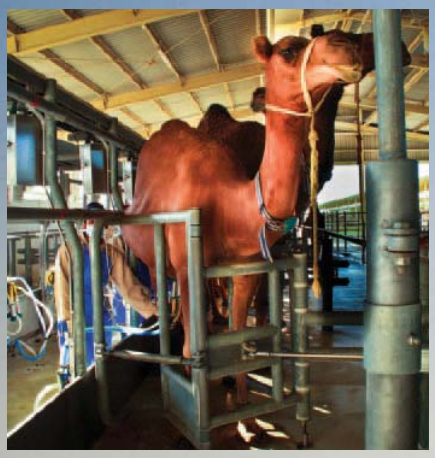
Dr Nagy obtained his veterinary degree at the University of Veterinary Sciences in Budapest in 1990 where he stayed until 1999 as an assistant professor. From 2000 to 2002 he worked in the Sultanate of Oman to develop artificial insemination and embryo transfer programmes in dromedary camels. He has been in Dubai since 2003 to develop and manage the world's first large scale camel milking farm where he has the farm manager position at present. He is a founding member of the European College of Animal Reproduction and his team carried out the first successful embryo transfer in horses in Hungary in 1996.

Emirate's Industry for Camel Milk and Products, trade name Camelicious, runs a herd of 2,500 camels and has everything from a mechanised milking dairy to camel milk processing, testing and distribution under one roof. It is owned by Sheikh Mohammed bin Rashid Al Maktoum, ruler of Dubai, and produces some 4,500 litres of camel milk a day.

Camel milk has to compete with cow's milk which is extremely popular, with one farm in the United Arab Emirates planning to import 3,000 calves from Holland this winter. Cows produce a calf every year and 40 litres of milk a day whereas camels produce a calf every two and a half years after a thirteen month pregnancy and on average produce between 5 and 10 litres a day whilst a few produce over 20 litres a day or continue to lactate for more than 700 days. Cows have to be kept in air conditioned sheds or sprayed with a cooling mist because of the intense heat in an area short of water whereas camels are adapted to the desert.

The aim of the study by Dr Peter Nagy, Dr Judit Juhasz and Dr Lulu Skidmore was to increase the number of offspring by superovulating high producing dromedaries during lactation and to transfer embryos into low producing recipient camels.

Ten, eight to fifteen year old, high producing lactating dromedaries were selected as donors at the end of the breeding season and were milked by machine twice a day. Donors were induced to ovulate with Receptal and on Day 4 after ovulation they were treated with a combination of Folligon and Folltropin in declining doses over a period of four days. Donors were mated to a fertile bull twice twenty four hours apart when the follicles reached 10 to 15mm in diameter and embryo recovery was carried out on day seven after ovulation. The embryos were transferred non surgically into recipients that had been induced to ovulate one day after the donors and pregnancy was diagnosed by ultrasonography and serum progesterone determination at 14, 21, 35, 60 days and five months. Superovulation was successful in nine out of ten camels resulting in 56 embryos recovered with a significant variation in the recovery rate of between 12 and 76%. Embryos were transferred into 46 recipients, 36 single



and 10 twin transfers, and the pregnancy rate at 14, 21, 35, 60 days and five months was 47.8% (22/46), 43.5% (20/46), 39.1% (18/46), 34.8% (16/46) and 32.6% (15/46). Pregnancy loss between 21 to 60 days was 20%.

This is the first report in which high producing lactating dromedaries were selected as donors for an embryo transfer programme. The authors concluded that assisted reproduction has great potential and an indispensible role in accelerating genetic improvement in the dairy camel industry.

Fourteen calves have been born and another 50 surrogate camels are currently pregnant. It has not been proven yet whether, like other animals, high milk producing camels' offspring will produce similar amounts of milk. The calves have to grow up first.

For the past 20 years camels have been selectively bred in the United Arab Emirates for racing. It is an extremely popular sport and customised tracks have been built throughout the country for the racing season that runs from October to April. Top speed for a racing camel is 40mph for short distances, they can run at 18mph for one hour or 7mph for up to 18 hours.

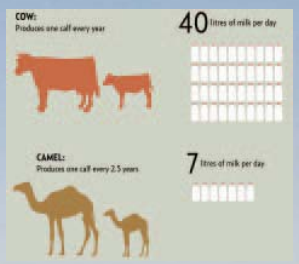
Farm manager Dr Peter Nagy says that they have milk producing camels from different regions of the world and their milk production average is the same, therefore camels have never been selectively bred for milk production.

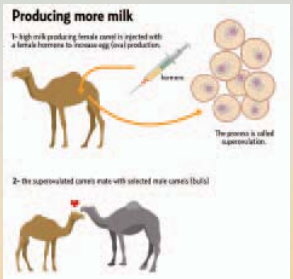
Camel milk does have great advantages. It contains five times more Vitamin C than cow's milk, ten times more iron, a shelf life of two weeks for pasturised milk and its protein structure is similar to human milk. Research at the Central Veterinary Research Laboratory in Dubai indicates that drinking half a litre a day provides the recommended daily amount of Vitamin C and that it is ideal for people with lactose intolerance or allergies, aids cardio-vascular functioning and can lower cholesterol. It has always been a staple of the Bedouins and was used by women for its anti-ageing and natural healing properties.

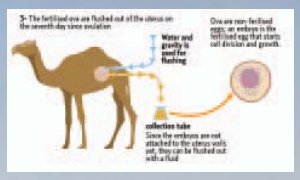
On farm the camels are trained to twice daily file into specially designed pens and allow themselves to be milked as the goal is to have relaxed and easily handled animals. In the farm compound calves are kept in pens

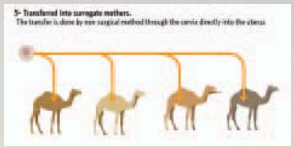
close to their mothers and there is also a four kilometre walking track as camels are naturally free roaming animals.

Camelicious is also attempting to bring back a camel milk drinking practice, that was almost lost due to urbanisation, by introducing camel milk into schools. The possible expansion of products made from camel milk includes cosmetics, cheese, ice cream and milk powder.

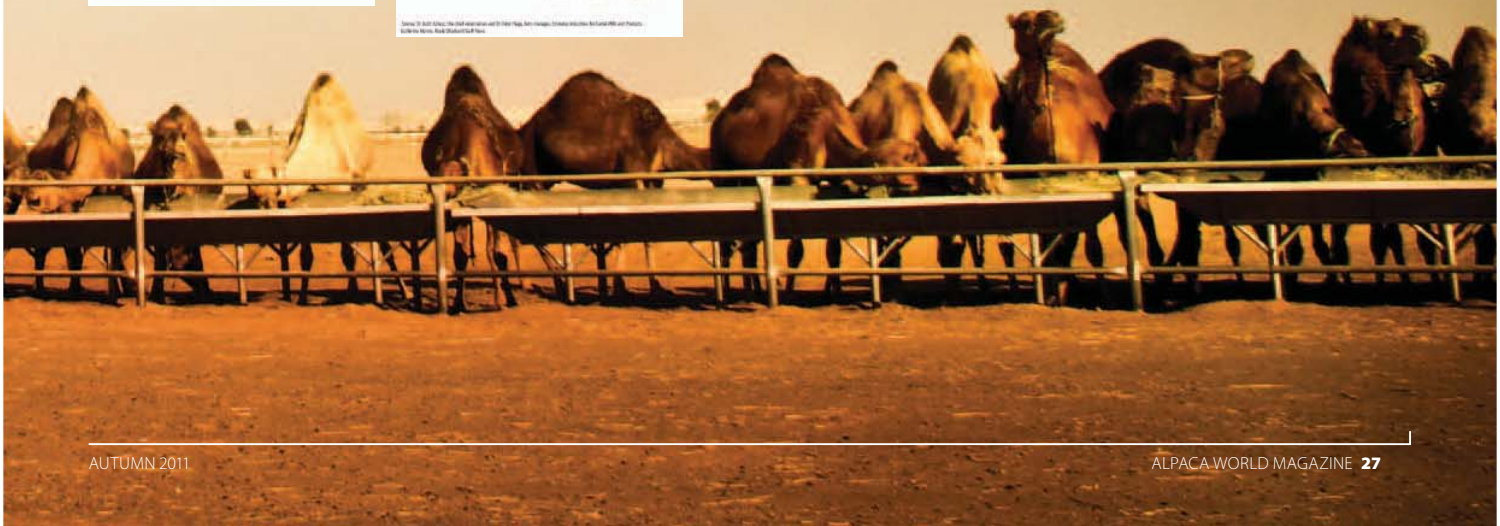








Camel milk does have great advantages. It contains five times more Vitamin C than cow's milk, ten times more iron, a shelf life of two weeks for pasturised milk and its protein structure is similar to human milk.



Expected Progeny Differences were the subject of one of the Breeder Breakout sessions at the Houston Conference now that the two EPD schemes in the USA have merged into one run by the Alpaca Registry Inc. The Registry in the USA does not allow ET cria to be registered, unlike our BAS Registry, and the ensuing discussion mainly dealt with breeders' misgivings about reproductive technologies. Clearly the European situation is a little different from the USA but **Mike Safley**'s article has lessons for us all in finding a sustainable future for alpaca farming.

alpacas in the

I am at heart an optimist and I believe the transition that I am suggesting is both possible and profitable.

ALPACAS HAVE HAD A GREAT RUN. Beginning in the United States in 1984 the herds grew, alpacas spread to countries around the world and a lot of people made good money raising alpacas. The boom has been fuelled by shows, promoters, a population moving to the country, demographics and the svelte alpaca's natural charisma. Then along came a debt crisis, sub prime mortgages, and unemployment. The question is; what's next.

I am at heart an optimist and I believe the transition that I am suggesting is both possible and profitable. Below you will find a three point plan that is the basis of my optimistic view of the future for alpacas.

Today people make economic decisions based on more basic prospects of risk and reward. The pet industry model, the collector's model and the show model are in decline. How can a committed alpaca farmer see their way to a profitable future? I believe we need to adopt concepts found in the tried and true traditional live stock models; 1) we need to replace selection by show judges based on phenotype with selection using EPD's that are based on genotype 2) we need to cull alpaca that are not improving the breed using the surgeons scalpel, advanced breeding techniques such as embryo transfer and heaven forbid the me... mar..., (I'm sorry I just can't bring myself to say it) and 3) we need a fibre collection and sale system based on the bailing machine and the international cash market for fibre.

1. Expected Progeny Differences

Expected progeny differences (EPD's) represent the future of breed improvement. This selection system overcomes the problem of the genetic variability inherent in small herds; the lack of selection accuracy based solely on phenotype; and the barn blindness that afflicts so many breeders.

An EPD is an estimate of the genetic merit of an animal for a single trait. The EPD is the expected difference between the performance

future: 1-2-3

of a specific animal's progeny for a specific trait and the average performance of all progeny for that trait. Their use maximises the following genetic principals.

There are four basic genetic prerequisites for rapid breed improvement: EPD's allow a breeder to maximise the value of these scientific principals.

1. **Genetic variability**
2. **Selection intensity**
3. **Selection accuracy**
4. **Generational interval**

Genetic variation is extremely important to the rate of gain. The more variation for a particular trait in a population, the more potential there is for change. If breeders have a wide variety of animals to choose from–such as those with high or low fleece weights–they can select alpacas with high fleece weight and breed for the trait. Improvement in fleece weight will be rapid.

Selection accuracy is important if any improvement or gain is to be made. This means the traits you select for must be heritable. Accuracy assumes that we have the ability to separate superior and inferior animals. If you select for a heritable characteristic, such as fleece weight, you must identify superior stud males who historically have produced offspring with higher than average fleece weights to insure the trait is passed to the offspring. The same goes for fineness, crimp, staple length, etc. **The single most effective way to do this is by establishing EPD's.**

Selection intensity means being highly selective of progeny produced by the parents you have chosen for foundation stock, and retaining in your herd only the offspring that exhibit a superior expression of the trait under selection. This ensures that breeding values will remain high and that each generation of offspring should improve: The higher the selection intensity, the higher the rate of genetic gain.

Generational interval affects the rate of genetic change simply because the more rapidly one generation replaces the previous one, the faster the potential gain. Mice reproduce more quickly than humans, producing 150 generations in the time it takes humans to produce one. (This makes it much easier to effect change in mice than in humans. And improving people is a problem because there is very little culling undertaken.)

Generational interval is determined by the average age of the producing males and females in a given herd. Alpacas have a generation interval of four to six years for females and approximately five years for males, although this interval will vary from herd to herd. You can calculate the interval in your herd by dividing the number of alpacas into the total of their ages. A shorter generational interval means faster gain.

The Alpaca Registry (ARI) provides a free service available to all of their members to calculate their EPD's. You can visit ARIlist.com for complete details. EPDs are the proven method for wholesale genetic breed improvement in most if not all commercial livestock breeds.

2. Embryo Transfer (ET)

Embryo Transfer will capitalise on the selection power of EPD's by identifying the most productive females and mating them using multiple embryos to the most productive males. There will be several market enhancements resulting from this approach 1) a good market for low priced females will be developed to be used as ET recipients, 2) low quality females will be removed from the gene pool as they are used as recipients 3) breeders will be more willing to make their best genetics for sale in the market place and 4) there will be an enhanced export market where the best genetics can be exported as embryos inside a recipient while simultaneously remaining in your herd. This last point is a twofer 1) you make a high value sale while 2) shipping out one of your lowest quality females.

Here is what Robert Gane of Canchones Alpacas in Victoria, Australia had to say about ET after years of experience and more than 300 ET cria:

"The use of ET has had a significant impact on the success of our breeding program and business. It has allowed us to rapidly improve the quality of our herd. It has also allowed us to make available these leading genetics to our clients." You can access the entire article at **www.canchones.com.au/downloads/EmbryoTransfer.pdf**.

The science of ET is now at the point of being well tested and proven. For those who are interested in exploring this option you can visit the ARI website and review a number of scientific papers and presentations that were made at the ARI sponsored Genetic Conference in Houston, Texas.

3. A Commercial Fibre Market

This is the decidedly low tech component of the three part plan. All this requires to implement is a baling machine and a scale. Most alpaca breeders I know want a check for their fleece. They are tired of fancy value added coops, shipping fleece off with a check to get yarn that they must either process into a product or market in the cottage industry store at their farm. While this may work for some folks it is not the preference of the majority of breeders that I talk to. Put simply, to become a truly accepted livestock breed we need a cash market for our fleece.

There is an international market for alpaca fleece every day. To access the market the fleece needs to be 1) bailed into 400 pound bales 2) core tested for quality per bale and 3) aggregated in 20,000 to 40,000 pound lots. If these conditions are met fleece becomes a cash commodity. It can be sold greasy based on quality and shipped economically. It takes 40,000 pounds to fill a large container, 20,000 pounds for a small one.

There are currently several fledgling projects underway that have the potential to make access to the cash market a reality. The most advanced and sophisticated plan is sponsored by Australian Alpaca Fleece Limited **www.aafl.com.au**. Here are excerpts from their plan:

Australian Alpaca Fleece Limited; Experience has proved the need to closely match Australian fleece prices to world alpaca prices. **The Board wishes to continue to purchase ALL types and grades of alpaca fleece as a service to Australian growers.**

We have adopted a **simpler** system of paying a flat price per kilo for the **WHOLE FLEECE weight, regardless of length, but heavy contamination, lower legs and belly hair should be excluded and placed in rubbish bins.**

The fleece will be graded by our expert classers into one of four categories so that a grower purchase price can be set for each fleece.

The fleece categorisation criteria will be:

Category	Expected to have
X-Fine	73% of the fleece under 22 µ
Fine	57% of the fleece under 22 µ
Medium	11% of the fleece under 22 µ
Adult	2% of the fleece under 22 µ

The following prices in Australian dollars per kg are offered for the 2011/12 season, effective immediately:

	X-Fine (*) under 19µ	Fine (*) under 22µ	Medium (*) under 25.5µ	Adult (*) under 32µ
White (**)	3.57 (2.70)	2.96 (2.19)	1.51 (0.93)	0.58 (0.30)
Colour (**)	2.55 (1.90)	1.93 (1.40)	0.26 (0.15)	0.10 (0.10)

(*) Prices are A$/kg of whole shorn fleece including neck and pieces, GST excluded.
(**) Includes light fawn 'near-white'.
(Bracketed prices for previous year)

OFFER TO PURCHASE CLASSED AND BALED GROWER FLEECE

The AAFL Board has decided to offer larger growers and regional groups the opportunity to sell pressed bale lots to AAFL on the basis of independent Australian Wool Testing Authority (AWTA) bale test certification.

Pressed bales over 100 kg and up to 170 kg per bale may be offered to AAFL on the basis of a faxed or emailed AWTA test.

Put simply, to become a truly accepted livestock breed we need a cash market for our fleece

AAFL will then offer to purchase individual bales solely on the basis of the AWTA certificate.

Requirements:

1. All baled fleece must be classed.
2. Each bale marked with grower name/AAFL number and bale number.
3. Pressed clean woolpack bale between 100 - 170 kg, weight marked.
4. Machine-sampled bale test sent to AWTA
5. AWTA certificate showing at least:
    1. Mean micron
    2. Micron Standard Deviation (SD)
    3. Micron Coefficient of Variation (CV)
    4. Comfort Factor
    5. Fibre Length

These prices might seem much lower than what you have heard over the years and they may well be too low but they are a start and they have the advantage of being real today. Not a promise of some future payment from a coop who promises to turn your fibre into socks or sweaters if only you will pay ridiculous prices to ship and process your fibre: all before receiving a dime.

These prices are also very sensitive to fleece quality and fineness. If breeders were to sell into a cash market you would see quality on the farm skyrocket in response to higher prices for higher quality fibre. Selection fuelled by EPDs and ET would rapidly increase the value of our annual clip. Consider the following potential for prices based on quality.

Alpaca Fibre Market (Prices are in $/lb. at various dates in time)	
Ultra-fine wool, 19 micron	$ 5
Baby Alpaca, 21.5 micron	$10
Royal Baby, 19.5 micron	$19
Alpaca, 18.5 micron	$36
Cashmere, 15.5 micron	$53
Alpaca, 16.25 micron (estimated)	$123
Vicuna, non-de-haired, 13.5 micron	$227

RACHEL HEBDITCH UK ALPACA

In 2012 UK Alpaca will pay £12 plus VAT a kilo for white baby and £8 a kilo plus VAT for white fine. It is graded on handle of course but baby is around 21m and below, fine 22-26m. For the colours they pay £8 a kilo for baby and £5 a kilo for fine grade, both plus VAT which is 20%.

DAWSON & ACKROYD (UK CLOTH MANUFACTURERS)

A company called Dawson & Ackroyd (cloth manufacturers) has started to buy raw fleece in the 26 to 30m range and they are paying £5 a kilo including VAT. So far they have collected five and a half tons although this is not yet a commercial quantity for them.

Alpaca Ultimate is an independent, self funded group buying fleece to make a range of products in Australia and New Zealand. They are currently buying solid white & light to medium fawn well skirted huacaya fleeces. Prices valid from 1st July 2010.To fit the criteria fleece should be no more than 25.9 micron on a mid side. You must also ensure your fleeces are within the length parameters of 80 - 120m

	Microns	Comfort factor	Length	Price
1	Under 16	100%	80 - 120 mm	$66 per kg inc. GST
2	16 to under 18	99%	80 - 120mm	$44 per kg inc. GST
3	18 to under 20	97%	80 - 120 mm	$30 per kg inc. GST
4	20 to under 22	95%	80 - 120 mm	$18 per kg inc. GST
5	22 to under 24	90%	80 - 120 mm	$13 per kg inc. GST
6	24 to under 26	85%	80 - 120mm	$10 per kg inc. GST
7	26 to under 28			$8 per kg inc. GST

(Source Julie Mae Campbell)

THE ALPACA FIBRE AUCTION PROJECT

alpacafiberauctionproject@gmail.com; Julie Mae Campbell and Mary Ellen Perry. Their objective is to connect the grower to the commercial alpaca fibre buyers. Many breeders have fewer than 50 alpacas but by combining like fleeces from each herd and creating large quantities of quality alpaca fibre that are attractive to the commercial alpaca fibre buyer. The minimum quantity necessary to make this work is 20,000 pounds.

Julie Mae says "About the auction: The fibre will run through Roswell Wool in Roswell New Mexico. I am dealing with Mike Corn. Roswell has a warehouse here in Long Beach California which makes it easy for me to keep track of this project. The auction is by sealed bid.

To the question what price do I expect, well, if you gave me a lot of room to squirm you might get me to admit to about $5 per pound for grade 3 white. This price is based on conversations I have had with Mike and the current pricing for mohair and better grade wools, and from conversations with Liz Valkamp, Claudia Raessler, Wini Labreque and Peter Lundborg. All these folks are currently buying alpaca fibre for a variety of projects here in the States.

The interesting question is, have they been paying too much, or getting away with paying too little?"

(Source Julie Mae Campbell)

SURIPACOS

SuriPacos purchases greasy fleece for cash. They pay $3.00 to $6.00 per pound depending on grade. Claudia and Ken Raessler have been operating this program for several years and they are purchasing more fibre each year. Claudia notes that she has seen fibre quality increase year over year. They often buy small quantities and will negotiate better prices for larger quantities.

I have often heard that there can be no fleece market until we have x number of alpaca; 50,000, 100,000, 200,000 or 500,000. Consider that there are approximately 3,000,000 alpacas worldwide. There are about 250,000 in the United States. That means that if the U.S. decided to create a commercial fibre market as described above they would control almost 10% of the worldwide production. We would produce about 1,250,000 pounds of fibre (250,000 alpacas x 5 pounds per alpaca) with a market value of between $1,875,000 at $1.50 and $6,250,000 $5.00. A more likely economic analysis, especially in the beginning would be to assume that 20% of the clip would sell for $10.00 a pound as baby or better, that 40% would sell at $5.00 a pound at microns from 22 to 27 and that 40% would sell at $1.50 a pound as coarse from 28 microns and up This would be a significant infusion of cash into our industry. The U.S. National clip would be worth the following amount according to this scenario.

Sale of 250,000 pounds of alpaca fibre	
50,000 pounds of baby	$400,000.00
100,000 pounds of fine	$500,000.00
100,000 pounds of coarse	$150,000.00
Total	**$1,050,000.00**

The three point plan would accelerate quality based selection decisions using EPDs and ET together with feedback from fleece sales and it would establish alpaca as a legitimate livestock industry.