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ABSTRACTS

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(Eds.)

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CONTENTS

LECTURES

Evaluation of the alpaca genealogical registry in Peru.
W. Trejo, P. Avalos and E. Reynoso, Peru

Two selection methods applied in alpacas during three generations on fiber length thickness and fleece weight.
J. Raunelli Sander, J. Bazan and M. Cabrera, Peru

Friday 8th October, 2004

SESSION III: REPRODUCTION AND PATHOLOGY

Transvaginal embryo biometry in alpaca *(Lama pacos)*. Preliminary report.
G. Catone, M. Basile, O. Barbato and C. Ayala C., Italy, Bolivia

Embryo transfer in camelids: Study of a reliable superovulatory treatment in llamas.
W. Huanca, M. Ratto, A. Santiani, A. Cordero and T. Huanca, Peru, Canada

The influence of high ambient temperature on thermoregulation, thyroid hormone and testosterone levels in male llamas (*Lama glama*) depending on their fibre length.
Anja Schwalm, G. Erhardt, M. Gerken and M. Gauly, Germany

Skin lesions in UK alpacas (*Lama pacos*): Prevalence, aetiology and treatment.
G. L. D'Alterio, Italy

Evaluation of the immune response to vaccination against C. pseudotubercolosis in an alpaca herd in Italy: Preliminary results.
Daniela Beghelli, G.L. D'Alterio, G. Severi, L. Moscati, G. Pezotti, A. Foglini, L. Battistacci, M. Cagiola and C. Ayala Vargas, Italy, Boliva

Course of gastro-intestinal parasite and lungworm infections in South American camelids on a farm in central Germany.
Simone Rohbeck, M. Gauly and C. Bauer, Germany

Case reports in South American camelids in Germany.
R. Kobera and D. Phöle, Germany

SESSION IV: NUTRITION

DECAMA-Project: Determination of the lactation curve and evaluation of the main chemical components of the milk of llamas (*Lama glama*).
C. E. Pacheco Murillo and A. Soza, Peru

Meta-analysis of glucose tolerance in llamas and alpacas.
C. K. Cebra and S. J. Tornquist, USA

Alpaca nutrition and adaptability at world-wide level.
Maria H. Bravo, USA

Saturday 9th October, 2004

SESSION V: MEAT AND FIBRE PRODUCTION

DECAMA-Project: Income and production cost analysis of domestic South American camelids' meat in Latin American countries.
F. Ansaloni, F. Pyszny, A. Claros, H. Lamas, R. Marquina and J. Zapana Pineda, Italy, Argentina, Bolivia, Peru

DECAMA-Project: Evaluation of the carcass quality of alpacas and their classification.
G. Condori Choque, C. Ayala Vargas, N. Cochi Machaca and T. Rodriguez, Bolivia

DECAMA-Project: The effect of manual dehairing on the quality of llama fiber(*Lama glama*)
S. Pilco, J. Zapana, J. Delgado, C. Ayala Vargas and Z. Martinez, Bolivia

DECAMA-Project: Technological and nutritional parameters of fresh meat of Argentinean llamas (*Lama glama*).
Ana P. Zogbi, E. N. Frank and C.D. Gauna

The biology of fibre production.
H. Galbraith, UK

DECAMA-Project: Preliminary data on Bolivian llama skin follicular structure.
T. Lusky, A. Valbonesi, T. Rodriguez, C. Ayala Vargas and M. Antonini, Italy, Bolivia

Variability of vicuna fibre diameter in the protected natural area of Peru.
J. Ayala, M. Lopez and J. Chavez, Peru

DECAMA-Project: Women of mountain in business of charque of llama.
A. Claros Goita, J. L. Quispe, A. Claros Liendo and J. Flores, Bolivia
Video-presentation (spanish, english)

SESSION VI: FREE PAPERS

Study of setting up a new national alpaca enterprise: model based on the UK alpaca industry 1996-2004.
J. Gaye, UK

The European Endangered Species Programme (EEP) for vicunas.
C. R. Schmidt, Germany

11.000 years of camelid use in the Puna Atacama.
D. E. Olivera and H. Yacobaccio, Argentina

POSTERS

SESSION I: SUSTAINABLE DEVELOPMENT

Size and growth of the guanaco population at Calipuy national reserve.
J. E. Ayala

Preliminary evaluation of the sustainable use modules of the vicuna in Peru.
W. Trejo, Y. Huaco and R. Esponda

Argentine legislation impact on guanaco exports.
D. Wowczuk

SESSION II: BREEDING AND GENETICS

Morphological variation of Italian alpaca population. I. Mendelian and qualitative characteristics.
G. De Fidelibus, A. Vecchi, G. Minucci, G. Lebboroni, M. Antonini and C. Renieri

Paternity testing using microsatellite DNA in alpacas (*Vicugna pacos*).
J. Rodriguez, C. Dodd, J. C. Wheeler and M. W. Bruford

Morphological variation of Italian alpaca population. II. Biometric characteristics.
A. Vecchi, G. De Fidelibus, G. Minucci, G. Lebboroni, M. Antonini and C. Renieri

SESSION III: REPRODUCTION AND PATHOLOGY

Referral service for South American camelids at the University of Bristol Veterinary School: A review of cases from 1999 to 2002.
G. L. D'Alterio and K. J. Bazeley

Breeding and/or handling problems? Causes of death in camelids.
Ilona Gunsser, T. Hänichen and C. Kiesling

Embryo mortality and its relation with the phase of follicular development at mating in alpaca.
W. Huanca, M. Cervantes and T. Huanca

Effect of oestradiol on embryo mortality in llamas.
W. Huanca, J. Palomino and T. Huanca

Biology of *Eimeria macusaniensis* in llamas.
Simone Rohbeck, M. Gauly and C. Bauer

Changes in testicular histology and sperm quality in llamas (*Lama glama*) following exposure to high ambient temperature.
Anja Schwalm, G. Erhardt, M. Gauly and M. Bergmann

Seroprevalance of *Neospora canium* and *Toxoplasma gondii* in South American camelids.
D. Wolf, M. Gauly, C. Bauer and G. Schares

SESSION IV: NUTRITION

Determination of internal organ weights in llamas and alpacas.
C. K. Cebra, R. J. Bildfell and C. V. Löhr

SESSION V: MEAT AND FIBRE PRODUCTION

DECAMA-Project: The model slaughterhouse of camelids of Palcoco, La Paz, Bolivia.
A. Claros Goitia, J. L. Quispe, A. Claros Liendo and J. Flores

DECAMA-Project: Analysis of the factors that condition the production of lama meat in the Puna of Jujuy: studies of cases in the Humid Puna and the Dry Puna.
H. Lamas

DECAMA-Project: Yield and quality of the dihaired llama fiber of the community of Phujrata.
N. Cochi Machaca

DECAMA-Project: Supply and demand characteristics of alpaca meat and charqui.
N. Pachao

An Evaluation of the growth and change in body dimensions from birth to maturity of the llama (*Lama glama*) and the huarizo (crossbred camelid) in the Bolivian Andes.
B. R. Southey, T. Rodriguez and D. L. Thomas

SESSION VI: FREE PAPERS

Support of the high land alpaca breeders by the Proalpaca project.
W. Trejo and J. Hernandez

Lectures

DECAMA-Project: SUSTAINABLE DEVELOPMENT OF CAMELID PRODUCTS AND SERVICES MARKETED ORIENTED IN THE ANDEAN REGION

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1. Context and objectives

The aim of the project is to improve the quality of life of the rural population through the development of meat production of Domesticated South American Camelids (Lama and Alpaca). The objectives are: the improvement of camelid meat production, the suggestion of new production technologies, the proposal of technical, commercial and socio-economic interventions and services in order to support the development of the meat market and the exploitation of meat by-products, to obtain more added value, the development of scientific interchange and the technological transfer.

2. Activities

The activities are divided into 4 Work Packages (WP). Work Package 1 (Meat Products); section Fresh meat (1.1.): technological and nutritional characteristics of fresh meat, classification of carcasses, tenderisation of carcasses by electric stimulation; session Processed meat (1.2.), sub section Traditional products (1.2.1.): technological and nutritional characteristics of charqui; sub-section new products and new technologies (1.2.2.): new processed products, new processing methods for charqui, organic products; section Added value (1.3.): by products of meat; section Relationship between meat and milk production (1.4.): human Andean population and milk, chemical composition of milk, lactation curve and relationship with growth, technology of milking.

WP 2 (Market and Services); section Market analysis (2.1.): demand and offer at the production and processing levels, different steps of the chain, final commercial value and productivity of chain, governmental and macro-economical influences on the sector; section Certification systems (2.2.): innovation of products and processing, labels, certification systems, traceability; section Sustainability (2.3.): sustainability level of production, processing and distribution, safeguard natural resources, enhance income production and social responsibility of producers. WP 3 (Exchange of information/experiences): exchange between all the partners, transfer to the industrial sector, to the producers, to different policy decision points. WP 4 (Coordination and evaluation): project management.

3. Expected results and outcomes

Expected results and outcomes of the project are: certification system for nutritional content, classification carcasses system, standardisation of traditional and new processed products, development of new products and technologies, standardisation of meat conservation and processing, network of NGO's and institutions involved in the Andean region development, analysis of meat market, guidelines for the development of the meat chain, certification of the meat production and processing, decalogue of criteria for sustainability of meat chain, Web site of the project.

Reference:

Homepage, DECAMA, http://www.decama.net/

ARTIFICIAL BREEDING IN ALPACAS

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The development of artificial breeding technologies in alpacas will increase the use and allow more economic movement of genetically superior animals nationally and internationally. Generation intervals are relatively long in alpacas because males are slow to sexually mature and females exhibit an extended gestation (11.5 months), so conventional breeding results in slow genetic gain. Assisted breeding technologies are being used to improve wool quality more rapidly than would otherwise be possible by natural mating in industries such as Merino sheep and Angora goats. However, the reproductive physiology of alpacas differs to that of other domestic livestock and remains poorly understood, therefore hindering the direct transfer of artificial insemination (AI) and embryo transfer (ET) technologies from ruminants to alpacas.

Male alpacas produce low volume, low density, high viscosity semen during an ejaculatory period lasting 15 to 20 minutes. There is extreme variation in semen quality both within and between males. It is essential to collect the best quality ejaculate in the first instance to ensure maximum numbers of live sperm are available to inseminate after extension and preservation. The configuration of the artificial vagina (AV) used to collect semen must be adequate for each male to assume a natural mating posture to ensure a representative ejaculate is produced. The liner must have a suitable texture and be non-toxic to sperm and the temperature must be maintained at 38-42° C. The high viscosity of semen makes it difficult to extract semen from the AV and to mix with extenders. The low density of semen means that few doses per ejaculate are available for AI. Semen is deposited transcervically at the utero-tubal junction ipsilateral to the dominant follicle 24 hours after induction of ovulation in the female. While pregnancies have been easy to obtain from AI of fresh semen, it has been more difficult using chilled or frozen semen, despite post-thaw activity of up to 40 % using Triladyl® (Minitub) and Camel Buffer® (IMV) extenders.

The understanding of ovarian function in alpacas has been instrumental in the success of developing non-surgical, transcervical single and multiple ovulation ET. Females exhibit waves of ovarian follicular growth, with new waves emerging every 12 to 22 days. Follicle growth in the first 10 days after new wave emergence is consistent regardless of subsequent interwave interval. Females are induced ovulators, and ovulate 30 hours after copulation when they have a dominant follicle of at least 6 mm on either ovary. A corpus luteum develops on the ovary at the site of ovulation 3-4 days after mating and secretes progesterone. If conception does not occur, prostaglandin is released from the uterus and induces regression of the corpus luteum 10-12 days after mating. The embryonic signal for maternal recognition of pregnancy must be transmitted as early as Day 10 after mating in order to 'rescue' the corpus luteum of pregnancy as the corpus luteum is the major source of progesterone throughout pregnancy.

Single and multiple ovulation embryo transfer results in alpacas in Australia

	Single-ovulation ET	Multiple-ovulation ET
No. of donors flushed	340	87
No. embryos transferred	235	185
No. 60-day pregnancies	146	142
Percent pregnancies	43	163

WILDLIFE OR LIVESTOCK? DIVERGENT DEVELOPMENT PATHS FOR THE VICUÑA AS PRIORITIES CHANGE IN THE PURSUIT OF SUSTAINABLE DEVELOPMENT

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The unparalleled success of the international conservation effort of the last 30 years to recover populations of vicuña from the brink of extinction has resulted in widespread ambitions to derive income from sales of its fibre. Vicuñas are locally abundant in their four main range countries, to the extent that competition with domestic livestock for grazing resources is an increasingly important issue for pastoral altiplano communities. A condition for the relaxation of international regulations on trade under CITES has been that fibre harvesting should be non-lethal, and this has led to the establishment of a number of different models for exploitation based around the live capture, shearing and release of vicuña. Proyecto MACS, a research initiative with support of the EU INCO programme has been investigating the ecological, economic and social implications of alternative management approaches. Liberalisation has resulted in different strategies emerging in different parts of the altiplano largely as a result of diverse policy priorities in the different countries. This paper reports results from Proyecto MACS to demonstrate some of the implications of these management strategies for the vicuña and its continued conservation.

MIXED CAMELID-SHEEP HERDS, MANAGEMENT PRACTICES AND VIABILITY ANALYSIS: SOME CONSIDERATIONS FOR A SUSTAINABILITY FRAMEWORK OF ANDEAN PASTORAL SYSTEMS

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Andean pastoral systems developed original management strategies, such as herd diversification and controlled breeding, in order to cope with the highly harsh and uncertain environment they face. These strategies are sometimes difficult to assess on the sole technical criteria, and usually have to be analized on a long-term perspective. In this communication we aim to document how herd management strategies, particularly those related to herd composition (the proportion of llama and/or sheep) and to breeding and off-take practices, contribute to satisfy basic household needs and influence the sustainability of the pastoral system on the long-term.

These considerations are based on previous studies carried out for almost a decade, concerning the functioning of pastoral systems of the arid Bolivian highlands (Department of Oruro). Particularly, an extensive survey to assess factors affecting herd composition, and a herd monitoring of 14 pastoral households made it possible to characterize numerical productivity at weaning related to differentiated breeding (uncontrolled mating practices vs. selection for mating of specific females in the case of llamas; high or low care on mother-young relationship in the case of sheep) and off-take practices (early slaughtering or selling of males just after weaning, or delayed off-take). Finally, a model was built, using the viability theory, in order to put in perspective the incidence of these management practices together with climatic uncertainty on the long-term household survival.

Results show that llamas and sheep play complimentary roles in the functioning of the overall system, due to their differentiated biological characteristics and management. Raising jointly these two species is viewed as a sound strategy to spread different kinds of risks (drought periods, disease outbreaks, possibilities of choice for animal off-take in relation to reproductive capacities, market price fluctuations). The dynamic analysis shows that a control of the llama flock breeding rate strengthens the evolution of the mixed herd only when the herd is large enough so that a low off take rate satisfies the minimum family income, and that, in all cases, a mixed herd is likely to be more sustainable than a specialized one. Thus, the sustainability of the system, which can be analyzed here in term of meeting essential household needs whatever could happen, depends on the balance between the two species, managed with a variety of practices, and the wealth of the household. These considerations lead to propose a conceptual framework on the links between wealth of pastoral families and the range of practices they can mobilize in order to face environmental limitation and endogenous uncertainty related to decisions. Choices resulting of this balance will, hence, directly influence viability on the long-term of pastoral production units.

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LINKING VICUNA CONSERVATION AND COMMUNITY AIMS: THE CASE OF BOLIVIA

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Linking biodiversity conservation and community development aims is the goal in international conservation policies and promoted by integrated conservation projects and programmes. In the case of conservation of vicuna within the Andean region, regional policies have shifted away from strict protection to sustainable use and community based management. The general argument behind this move is that the generation and distribution of benefits from commercial use of fibre at community-level is likely to encourage local conservation.

This paper analyses this argument in Bolivia where sustainable use of vicuna and local participation is taking place in the absence of fibre commercialisation. The unit for accessing the legal right to sustainable use is the 'communal management area' assumed as the result of a collective action arrangement for vicuna conservation, management, generation and distribution of benefits. This paper reviews this assumption and the factors affecting it by analysing data collected during vicuna capture and shearing events in the Sud Lipez area (spring 2001) and Mauri Desaguadero area (spring 2002) based on participative observation and process documentation.

Findings show that the motivations to participate in collective action depend on the degree and combination of two groups of factors: those linked directly to past experiences (e.g. state-community partnerships, other development interventions) and those linked to the internal dynamics of local communities (e.g. issues of property rights and boundaries, power relationships).

RAISING CAMELIDS UP THE ANDES – AYMARA INDIANS ANIMAL AND VEGETABLE FARMING COMPLEMENTARITIES IN CHILE

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During 2003 and 2004 summer months, a joint Portuguese-Chilean team field researched Aymara Indian communities in extreme northern Chile, a millenary ethnic group still stubbornly inhabiting hard to reach adobe houses settlements, located up the Andes and high oasis valleys, persevering against all odds their nature respectful farming traditions.

Ancestral solidarity chains were always vital for Indian camelid herders' survival because very few vegetable farming can be practised 3,800 metres above sea level, quinua being a rare exception. Multiethnic occupation of the Andes and low valleys was closely intertwined with socio-economic complementarities from step to step, a sort of archipelago exploitation of the territory based in diverse ecological niches, characteristic of arid mountainous South American environments. Aymaras preferred to live in the high plateau though (average 4,000m) where along the years they built many villages in support of their essential activity, pastoralism, customarily developed in the wettest areas of the heights termed *bofedal*. Camel family species domesticated long ago were llamas and alpacas, resistant to the cold and lack of oxygen, bred for meat, milk and wool. Animals and herders come down to lower altitudes during the winter, namely to the following Pre-Andes mountains level, being traditionally cared via communal cooperation. In the second agro-ecological step (3,000-3,800m) potatoes, corn and fodder are cultivated in terraced slopes, irrigation channels having been present since immemorial times for scarce water distribution. As to the third level (2,000-3,000m) even nowadays it is subsistence agriculture dominated, diversified produce being river fed along the valleys, where potatoes, yucca and capsicum were adamant. Following European colonisation these were replaced by maize, fig trees and vineyards, tended in rare striking oasis within predominant cactus candelabra punctuated landscape.

The paper portrays traditional cultural aspects related to camelids' husbandry as well as their current status in Northern Chile.

GENETIC PARAMETERS FOR COAT CHARACTERISTICS IN BOLIVIAN LLAMAS

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Llamas display a great variability of fibre traits that determine the quality of the fleece as raw material. Delgado (2003) showed the variation between different populations in Bolivia. The population in the Province of Ayopaya, Department Cochabamba shows a high quality fibre. The aim of the study is to explore the genetic potential for this population and to investigate possibilities for the development of a breeding programme.

Fibre samples from 1869 single-coloured llamas were analysed with the optical fibre diameter analyser (OFDA). The following fibre traits were considered: Mean fibre diameter (MFD), standard deviation (SD), diameter of fine fibre (DFF), proportion of fine fibre (PFF) proportion of kemp (PK) and proportion of medullated fibre (PMF). The effects of type of llama, age, sex, coat colour and shearing interval were studied. The Th´ampulli type was superior to the Kh´ara type in all traits. With increasing age all traits except for PFF increased. Comparing the two sexes, females showed better fibre quality. Light colours tended to be of better quality than darker ones.

Heritabilities and genetic correlations were estimated using animal model procedures where all information came from mother-offspring relationships. Heritabilty estimates were 0.33, 0.28, 0.36, 0.32 and 0.25 for MFD, SD, DFF, PFF and PK, indicating potential for genetic selection.

GENETIC DIVERSITY AND MANAGEMENT IMPLICATIONS FOR VICUNA POPULATIONS IN PERU

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The aims of this study were to elucidate the recent evolutionary history and current genetic diversity of wild Peruvian vicuña populations with the intention of identifying demographically independent 'management units' within these populations and to assess the likely genetic effects of past and future management strategies, including the likely consequences of sustainable utilisation practices.

Twelve populations were sampled throughout the range of habitat and reserve coverage in Peru since they were thought to have had relatively long histories of demographic isolation and were not thought to have been influenced by recent translocations of animals from the Pampa Galeras reserve.

Blood or skin samples were collected and analysed with eleven previously published South American camelid (SAC) microsatellite DNA markers (Lang *et al.*, 1996; Penedo *et al.*, 1998).

These markers proved highly polymorphic and informative in Peruvian vicuña, with mean expected heterozygosity values over all loci varying between 0.377 (Tarmatambo) and 0.586 (Lucanas 2). A total of 20 private alleles were found which may be explained by the relatively low levels of within population compared with among population diversity and indicates some level of local isolation and genetic drift. Therefore, vicuña populations in Peru seem to possess several interesting and strong genetic features, which are a result of its biology, habitat occupancy, evolutionary history and management by people in the recent past.

The implications of these results for the future management of the Peruvian vicuña are that there should be four demographic management units North-western Junín, South Junín, Central Andes and Puno. Translocations of animals should only be carried out within the same, but not between different management units. Free movement of individuals within localities must be ensured to minimise further inbreeding and genetic drift

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EVALUATION OF LABORATORY TEST RESULTS OF CAMELIDS, MADE FOR IMPORT, EXPORT OR PARTICIPATION AT SHOWS

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Over the past ten years llamas and alpacas have become more and more popular in Europe. For that reason many camelids were imported from countries outside of Europe, or relocated within the EU-region. Until today a protocol exists to test for ruminant diseases in llamas and alpacas before they are allowed to pass the border. Although camelids belong to the separate suborder Tylopoda ("padded foot") within the order Artiodactyla, they are quite frequently misclassified as ruminants.

There are many differences between camelids and ruminants. One is, for example, that they are quite resistant to many government-regulated ruminant diseases. Since no special tests exist to diagnose these ruminant diseases in camelids, they are usually subjected to tests which are applicable to other species.

Altogether 9391 tests on 2546 llamas and alpacas were evaluated in this investigation. Among these, the most numerous tests were for Brucellosis (2535 cases), Leucosis (1499 cases), BHV1 (1619 cases), Tuberculosis (914 cases), FMD (738 cases), and Blue Tongue (507 cases). In addition to these, results of several other ruminant diseases which were tested in smaller numbers of animals (typically less than 300) are also presented.

The laboratories which provided these results were located in Europe (Switzerland, Germany, France, Italy, Sweden, Finland), the United States, Chile, and Peru. The results of this study were negative for the majority of the diseases tested. For the case of Brucellosis, 0.9% of the test results were false positive. The different laboratory tests and their results will be discussed in detail.

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EVALUATION OF THE ALPACA GENEALOGICAL REGISTRY IN PERU

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A study was made in order to evaluate the conduction of the Alpaca Genealogical Registry (RGA), implemented by the Consejo Nacional de Camélidos Sudamericanos (CONACS) in 1997. The genealogical registry is known as a tool of genetic improvement. The alpaca registry involves the following generational books: Identified (LAI), Definitive (LAD) and Pedigree (LCP).

The present study was developed in 2003 in all the country, by means of field works and laboratory, focusing on three items: (a) determination of the real amount of alpacas in the different registry books; b) evaluation of the qualification criteria in alpacas; and c) evaluation of the process of following animals into the RGA. The study showed: a) 4,319 alpacas were registered in the RGA and distributed across 156 breeders, who were later catalogued as breeder leaders; b) 9.35% of the total evaluated alpacas (46,207) were registered, existing a marked variation in the quality of the registered animals, which obligated to review the main racial parameters and to establish a better scoring system; and c) different interpretations were detected from the actual RGA statute, that caused confusion and loss of registered animal information. Consequently, a technical proposal was elaborated that clearly describes the process of inscription and following in alpacas, as well as the conversion of the Provisional Book (LAP) into a generational.

Registered alpacas in regions of Peru (2003)

Region	Breeders	LAI	LAD	LCP	TOTAL
Puno	29	2057	14	0	2071
Cusco	12	275	5	0	280
Arequipa	33	567	0	0	567
Junín	43	839	89	2	930
Ayacucho	7	24	0	0	24
Apurimac	18	201	0	0	201
Huancavelica	8	48	0	0	48
Lima	6	187	11	0	198
TOTAL	156	4198	119	2	4319

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CONSEJO NACIONAL DE CAMELIDOS SUDAMERICANOS (CONACS), 1995. Workshop to the Construction of the Alpaca Genealogical Registry

TWO SELECTION METHODS APPLIED IN ALPACAS DURING THREE GENERATIONS FOR FIBER LENGTH, THICKNESS AND FLEECE WEIGHT

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Twentyfour males and 202 offspring were evaluated in the application of two selection methods: the first is the comparison of the contemporany progeny from different males in a traditional mating system, and the second is based on the species specific biology with males choosing their females and building their harem.

Both methods were applied during three generations of family selection at the first shearing and corrected in the second one. The following results were obtained: the genetic parameters such as heritabilities, repeatability, and correlations between fiber length, fineness and fleece weight were higher for the response and the efficiency of the family selection as compared to the contemporany descendents. When males were allowed to choose their females within the herd and the family selection was applied, better results were obtained than with the other method.

When the BLUP mulitvariate animal model was used, similar results were obtained as above.

It is suggested that if males choose their females and the harem remains stable and family selection is applied, the progeny are influenced by the selection of the sires resulting in better results in the parental generation than in the traditional organisation of reproduction.

TRANSVAGINAL EMBRYO BIOMETRY IN ALPACA (*Lama pacos*). PRELIMINARY REPORT

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In human obstetrics the transvaginal ultrasonography (TVU) by means of high frequency transducers has been described as a repeatable procedure for the earlier and more accurate identification of embryo/fetal structures. In view of these advantages, a study was designed to measure the gestational sac diameter (GSD) and crown-rump-length (CRL) by means of TVU during the early pregnancy in alpacas.

Five adult female alpacas were examined from 12 to 60 days after copulation, in the Maridiana farm in Umbertide (Perugia, central Italy).

The pregnancy assessments were done by a microconvex 6,5 MHz transvaginal probe connected to an ultrasound apparatus (Logiq 100 PRO General Electric Medical System, U.S.A.), once a week. Sixteen embryonic vesicles and eighteen embryos were detected and measured. The gestational age (GA) valued by ultrasonic measurement of the GSD and CRL were in good agreement with the real gestation day, calculated considering as day 0 the mating day: the mean shifting resulted in 0.00 ± 2.24 days by the CRL, and in 0.00 ± 4.12 days by the GSD.

The regression formula that describes the relationship between GSD and GA is:
GSD: GA = (GSD + 33.982)/2.3777 $R_2 = 0.866$ $P>0.001$;
The regression formula that describes the relationship between CRL and GA is:
CRL: GA = (CRL + 26.218)/1.3038 R2 = 0.970 $P>0.001$.

These preliminary results indicate that the TVU could be an alternative method to the transrectal ultrasonography for the early pregnancy diagnosis in alpacas. In fact it is non-invasive, well tolerated and repeatable, offering high quality image, precocity and reliability of the pregnancy diagnosis.

No embryonic loss was observed during our study, but for validation of this method could be important to assess the plasma concentrations of $PGF_{2\alpha}$ metabolite during the ultrasound examination, considering that mechanical stimulation of the cervix and vagina may induce prostaglandin release in Camelidae.

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EMBRYO TRANSFER IN CAMELIDS: STUDY OF A RELIABLE SUPEROVULATORY TREATMENT IN LLAMAS

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Genetic improvement in camelids under Peruvian highland conditions is limited by the long gestation period, by traditional schemes of breeding in communities and by the breeding season from January to March.. The use of reproductive biotechnology such as embryo transfer would be an interesting alternative for genetic improvement in camelids but the development of protocols of super ovulation according to the special characteristics of camelids is required. The objective of the present study was to evaluate the response to super ovulation, embryo recovery rate and pregnancy in synchronized recipients.

Female llamas 4 – 6 years of age were used. Animals were evaluated with ultrasound to determine presence of a follicle ≥ 7.0 mm previous to a treatment of synchronization of the follicular wave. After 12 days ovulation was induced (Day 0) and super ovulation was induced with 1000 UI of eCG on Day 2. Prostaglandin was used on Day 5 and animals were mated on Day 6 with males of probe and on the same day females with the presence of follicles ≥ 7.0 mm were synchronized as recipients. Non-surgical embryo collection was utilized on Day 7 after mating with a 2-way balloon catheter passed through the cervix and flushing each horn with 250 ml of medium. Embryos were evaluated and transferred to recipients. Pregnancy was evaluated with ultrasound on day 20 and 30 after embryo transfer.

Number of follicles as response to the treatment of super ovulation was of 11.2 ± 2.4 follicles and the recovery rate was of 8.7 ± 1.5 embryos with a good quality and development but with differences in size. Embryo transfer was successful with a 42.8 of pregnancy determined by ultrasound on day 20 and 30 after transference. Results obtained suggest that is possible to use embryo transfer as an alternative in a program of genetic improvement in camelids.

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THE INFLUENCE OF HIGH AMBIENT TEMPERATURE ON THERMOREGULATION, THYROID HORMONE AND TESTOSTERON LEVELS IN MALE LLAMAS (*Lama glama*) DEPENDING ON THEIR FIBRE LENGTH

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High environmental temperature can cause heat stress in llamas and alpacas (FOWLER, 1998). This phenomenon is probably correlated with the ability of animals to thermoregulate depending on their fibre length.

The aim of the present study was to evaluate the influence of high ambient temperature on physiologic parameters, body surface temperature, thyroid hormones (triiodothyronine=T_3 and tetraiodothyronine=T_4) and testosterone levels in llamas in relation to the fibre.

12 fertile male llamas were housed in heated stables during the study. 5 of the animals were shorn (< 1cm), 5 animals were left unshorn and 2 animals were shorn partly (middle of the body). After a short acclimatisation period, the ambient temperature was raised up to 30°C for 4 weeks. Subsequently the temperature was lowered during one week down to 20°C, then the animals were allowed to recover for at least 7 weeks at 20°C.

Rectal temperature, heart rate and respiratory rate were measured daily. In addition the body surface temperature was measured by infrared thermography. Serum thyroid hormone and serum testosterone levels were evaluated once a week.

All animals showed higher respiratory rates ($p<0.001$) and rectal temperatures in the heat-period when compared with the recovery-period. Respiratory rate was above the physiological values in the heat period. The rectal temperature stayed within the physiological range.

The shorn animals were able to cope better with the high ambient temperature and showed significantly lower rectal temperatures and respiratory rates during the heat-period compared to the half- and unshorn animals. The body surface temperature was significantly lower in the unshorn regions of the animals compared to the shorn parts. The heat loss in the unshorn animals was concentrated on the ventral body regions (the thermal windows), which indicates that effective thermoregulation can only take place in this part of the body.

In the heat-period the thyroid hormone levels (T_3 and T_4) were both significantly lower compared to the recovery-period. The two thyroid hormone levels were significantly correlated.

The serum testosterone level showed a decrease one week after the heat-period, with a minimum level 2 weeks later, followed by a slow increase with the levels still below the initial values until 6 weeks after the heat-period. There were no significant differences in the testosterone levels between shorn and non shorn animals.

The high ambient temperature significantly affected the physiologic parameters and the thyroid hormone levels in all llamas. In unshorn animals an effective thermoregulation can only take place over the thermal windows. Shorn animals can tolerate heat better because of the heat loss over the entire body surface.

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SKIN LESIONS IN UK ALPACAS (*LAMA PACOS*): PREVALANCE, AETIOLOGY AND TREATMENT

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South American camelids, especially alpacas, are increasingly popular in the United Kingdom. Reports received from breeders and veterinarians suggested that skin disorders in alpacas were common in the UK population, and treatment often unrewarding. A series of studies were undertaken in order to establish the prevalence of the skin condition/s, define a plausible aetiology, and consequently develop a protocol of treatment.

The members of the two British camelid breeders' associations were surveyed by means of a postal questionnaire. Given the lack of up-to-date data, the survey aimed to characterise the UK South American camelid population, and the prevalence and features of skin disease. A total of 3520 camelids were counted, of which 77.2 per cent were alpacas and 20.6 per cent llamas (*L. glama*). Occurrence of skin disease was reported by 51 per cent of respondents. Zinc deficiency and ectoparasitism, presumptively diagnosed, were listed as the cause of disease by 31.9 per cent and 26.4 per cent of respondents, respectively.

Based on the results from the previous study and the recurrent isolation of *Chorioptes sp.* mite in conjunction with skin lesions from case material referred to the author, a study on the prevalence of mite infestation in alpacas was initiated. A total of 209 alpaca in nine units in the south-west of England were included in the study. Forty-seven (47/209; 22.5%) showed signs of skin disease. In the sampled population, 33 alpaca (33/83; 39.8%) were positive for *Chorioptes sp.* mite.

The efficacy of Eprinomectin® vs. Ivermectin®, and the field efficacy of Eprinomectin® for the treatment of chorioptic infestation in naturally infested alpacas were assessed in two studies. No localised or systemic side effects were observed in either trial. The Eprinomectin® protocol employed in Study 2 proved highly effective at controlling parasitic burden in alpacas naturally affected by chorioptic mange mites.

EVALUATION OF THE IMMUNE RESPONSE TO VACCINATION AGAINST C. PSEUDOTUBERCOLOSIS IN AN ALPACA HERD IN ITALY: PRELIMINARY RESULTS

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The applicability of some assays to evaluate the effectiveness of the immune function, as previously used in other animal species (e.g. pigs, cows and sheep), was tested in an Alpaca (*Lama pacos*) herd affected, since 2003, by Caseous Lymphadenitis (*Corynebacterium pseudotubercolosis*) and subject to a vaccination programme against the causative agent.

The vaccination programme was initiated following failure of controlling the outbreak by isolation and treatment of the initially affected animals.

An homotypic, autogenous inactivated and adjuvated (aluminium hydrossile) vaccine, administered subcutaneously at day 0 (A) and after 21 days (B) was used.

Blood samples were collected by venipuncture of the jugular vein on days 0, 21 and 42.

Sample in EDTA were analysed for standard haematological parameters. Serum obtained from whole blood with no anticoagulan was tested for: lysozyme serum titration (expressed in µg/m), serum bactericidia determination (expressed in %), semiquantitative complement titration (expressed in CH50) and gamma immunoglobuline (by electrophoresis) and IgGs concentrations (by Radial Immunodiffusion tests).

COURSE OF GASTRO-INTESTINAL PARASITE AND LUNGWORM INFECTIONS IN SOUTH AMERICAN CAMELIDS ON A FARM IN CENTRAL GERMANY

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A longitudinal study was performed in central Germany to obtain data on the saisonal and age-depending course of infections with gastro-intestinal parasites and lungworms in llamas and alpacas of a German farm where approximately 120 animals were kept in several groups on pasture throughout the year. Faecal samples of foals, yearlings and adult animals were collected in monthly intervals during a 12-month period (October to September) and examined using common parasitological techniques (McMaster method, Baermann funnel, coproculture).

Eimeria infections: Both the highest prevalence and intensity of total *Eimeria* oocyst shedding were observed, independent from the saison, during the first months of life and were significantly higher in foals (mean maximum: 16,000 oocysts per gram faeces, OPG) than in older animals (600 OPG). First, oocysts of *E. alpacae*, *E. punoensis* and *E. lamae* were detected in the faeces; shedding of *E. macusaniensis* oocysts started in the 2nd month of life. *E. ivitaensis* oocysts were sporadically found.

Gastro-intestinal helminths: The highest prevalence of trichostrongyle egg shedding (*Haemonchus*, *Ostertagia*, *Trichostrongylus*, *Cooperia*) was observed in late summer. Foals and yearlings showed higher trichostrongyle egg counts (maximum 450 eggs per gram faeces, EPG), on average, than adult animals (maximum 150 EPG). Eggs of *Nematodirus* spp. (*N. battus* and others), *Strongyloides*, *Trichuris*, *Capillaria* and *Moniezia* were repeatedly detected, mainly in the faeces of foals and yearlings. *Trichuris* egg counts were sporadically very high (maximum 2000 EPG) in some animals suggesting a possible risk for clinical disease.

Lungworms: Patent infections with the bovine lungworm (*Dictyocaulus viviparus*) were found in dams and yearlings, and a few animals showed slight signs of respiratory disease. Maximum shedding of lungworm larvae (14% in dams, 47% in yearlings) was observed during the winter months. There were hints that several animals imported from The Netherland had been the source of the lungworm infection on this farm.

CASE REPORTS IN SOUTH AMERICAN CAMELIDS IN GERMANY

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Three different kinds of case studies in alpacas are presented.
Firstly the aetiopathology of an acute kidney failure in a 6 months old female alpaca, caused by a systematic yeast infection is described. The animal had a major disorder to urinate. The urine analysis showed high contents of *Candida albicans*. Although the animal could urinate again during the treatment, it died after two weeks. As the pathological and histological analysis revealed, there was a high inflamation, caused by a endomycosis, especially in the kidney, pancreas, spleen and myocardium tissue as well as in the cerebric.

The second case describes the application of a herd specific vaccine against pseudotuberculosis in an alpaca herd of 8 animals. *Corynebacterium pseudotuberculosis* was isolated during the bacteriological examination of the lymph knots. From this strain a herd specific vaccine was made. During the vaccination period the animals with increased lymph knots showed distinct visual signs of improvement. After 2 animals died at the beginning of the vaccination period, no further deaths occurred.

The third case describes the clinical aetiopathology of a 3 year old male alpaca infected by the borna virus. While the animal showed distinct signs of lameness on the hind limbs, the blood parameters had almost normal values. X-rays suggested hypoplastic cristas of the knees. Since during the course of the disease the animal showed increasing signs of ataxy it had to be put down. The pathohistological examination of the brain revealed the existence of a highly, non-sanious Encephalitis, which was characterised by distinct lymphocytic and perivascular infiltrates. PCR and immune histology confirmed the occurrence of the Borna virus. The examination of the three remaining camelids of the herd for Borna virus antibodies produced negative results.

DECAMA-Project: DETERMINATION OF THE LACTATION CURVE AND EVALUATION OF THE MAIN CHEMICAL COMPONENTS OF THE MILK OF LLAMAS (*Lama glama*)

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The objectives of the present work were: to analyze the lactation curve, to study the characteristics of the main components of llama milk (*Lama glama*) and to evaluate the growth rate of the foals according to the days of sampling post partum (pp).

The volume of the milk and the percentages of total solids, protein, fat, ash and whey protein, as well as the growth rate of the foals were evaluated in 6 mature llamas, of second birth and second lactation and their progeny maintained under conditions of traditional high Andean pasture management.

Milk samples were taken at days 1, 7, 30,60, 90, and 120 post partum. The taking of the samples was carried out between 12 am and 2 pm after fixing a muzzle to the foals in order to prevent suckling. The milking was carried out manually by placing the animal in a lateral position. The weight of the foals was registered immediately after the extraction of the milk.

The results obtained until day 120 pp show that in average, milk volume reached its peak by day 60 pp. The percentages of total solids, protein, ash and whey protein decreased with lactation length, whereas the percentage of fat increased during lactation. The growth rate of the foals increased continuously.

In the following Table the averages obtained for each of the traits recorded are summarized across the 6 females.

Summary of results obtained until day 120 post partum (pp) across 6 female llamas

Days of sampling (pp)	Total Solids (%)	Ash (%)	Fat (%)	Protein (%)	Whey protein (%)	Weight of foal (kg)	Milk volume (ml)
1	20.41	1.18	2.26	12.3	4.13	10.75	101.67
7	17.74	0.83	4.88	5.93	1.14	13.58	165.83
30	15.53	0.78	4.06	4.68	0.95	18.00	190.33
60	14.55	0.75	3.5	4.67	0.97	24.83	207.33
90	15.08	0.74	4.03	4.23	1.34	29.00	126.00
120	13.70	0.68	3.2	3.31	0.68	35.00	112.00

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META-ANALYSIS OF GLUCOSE TOLERANCE IN LLAMAS AND ALPACAS

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To investigate whether observed differences in glucose tolerance testing in New World could relate to the species tested or the gender of the subjects, data were compared from different trials using similar protocols and methods of analysis. In total, 5 adult female llamas, 9 adult llama geldings, and 22 adult gelded alpacas were administered 0.5 g/kg glucose as an intravenous bolus after an overnight fast. Blood was withdrawn for glucose determination before the bolus and 15, 120, and 240 minutes afterward from all camelids, and also 30 and 60 minutes afterward from all but 8 alpacas. Additionally, theoretical volume of distribution for glucose was calculated for all camelids at the 15 and 30 minutes time points.

Concentrations and the differences between the measured concentration and baseline concentration were each compared for differences between the three groups based on species and gender. Theoretical volumes of distribution were compared between the 3 groups for the 15 and 30 minute time points. Gelded alpacas had significantly lower absolute glucose concentrations and changes in glucose concentration than female llamas from 15 through 120 minutes after glucose administration, and than gelded llamas from 15 minutes through the conclusion of the trial.

There were no differences in absolute glucose concentration or change in glucose concentration between the 2 genders of llamas. Alpacas had a significantly greater estimated volume of distribution for glucose at both 15 and 30 minutes than either gender of llama. Estimated volume of distribution was not different between genders of llama at either time point. In the absence of data suggesting faster glucose clearance in alpacas, these findings suggest that alpacas may have a greater volume of distribution for glucose than llamas, and hence potentially require different dosing regimens for medications that distribute throughout the extracellular fluid compartment. They also suggest that the lower insulin response to hyperglycemia identified earlier in alpacas may be the result of lower peak glucose concentrations, not a greater degree of pancreatic insufficiency.

ALPACA NUTRITION AND ADAPTABILITY AT WORLDWIDE LEVEL

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All of the experts will agree with the fact that nutrition is by far the most important factor in the life and development of a Camelid or any other specie in the world for the same matter.

The difference between well nourished animals to a malnourished one can many times be visible to human eye, the problem rises when the human eye can not detect these deficiencies.

Yet, there is not an absolute feeding practice for Camelids and the reason lies on the fact that nutrition is and must be adapted directly to the environment where the camelids reside.

Furthermore in order to understand and be able to adapt llamas and alpacas in any location worldwide, it is necessary to comprehend how they subsist in their native environment.

Through our experience exporting and breeding alpacas in more than 8 countries in the world, we have found that the key elements in order to achieve full and successful adaptation of our camelids, are and have been; creating and feeding the correct diet with supplements, amino acids and minerals. All of them used as complements of their new environment and at the same time the correct diet has helped us achieving a smoother health transition from their native land to new territories.

Every country, every state and even every farm within the same province can have different nutrients in their soil; therefore the necessary nutrients for each farm's herd must be treated individually. Generalizing nutrition without taking into consideration the individual constituents of the specific new environment or farm could be of dreadful and deadly consequences.

Therefore, we would like to share with other farmers the knowledge we have gathered through the last 9 years, from first hand experience in adapting successfully more than 1000 alpacas around the world. In many instances we have counted with the absolute expertise of several well known veterinarians, other times they have come to us to ask our opinion and observations in the fields where our alpacas live.

Our talk would be divided in 3 chapters:

- Alpaca's Natural Habitat.- Environment and Activities.
- Alpaca's capacity to adapt to new environments and activities.
- Alpaca breeder's responsibility to help the adaptation process by providing the correct diet in the new environment for the alpaca.

DECAMA-Project: INCOME AND PRODUCTION COST ANALYSIS OF DOMESTIC SOUTH AMERICA CAMELIDS' MEAT IN LATIN AMERICAN COUNTRIES

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The scarce wealth of the Andean rural territories imposes the necessity to favour the economic development to improve the income of the population, the hygienic state and the quality of the products of animal origin (fresh and transformed meat). To start the development, according to a market logic, it is necessary to pursue the objective of the creation of income in the agricultural enterprises and to safeguard the natural resources (environment, water, livestock).

The principal interventions of agricultural policy that could favour the development consist in the offer of:

1 - professional technique and farm economic training services;

2 - infrastructures for the offer of the products on the market. Particularly, to stimulate the formation of co-operative and/or producers' associations for the common marketing of the agricultural products, to offer rational structures of butchery and systems of meat transport from the agricultural centers of production to the urban market.

The purpose of this paper consists of illustrating the first results of a comparative analysis on the formation of the income and the calculation of the production cost of camelids meat in some cases studies, groups of 5-7 farms with breeding of llama and alpaca representative of the more diffused Andean realities on the territories of Peru, Bolivia and Argentina (Abbadessa *et al.* 2004).

The data are technical (endowment and quantitative and qualitative variations of the production factors) and economic (products sales and varying and fixed expenses of the enterprises) and they refer to the year 2003. The source of the data is represented by some farms groups, homogeneous from the point of view of the productive system and the endowment of the production factors. The collection of the data has been conducted by technicians, with the use of a homogeneous questionnaire for the different countries, through business visits and direct interviews to the agricultural entrepreneurs.

The analysis results consist in the elaboration of balance sheet (calculation of the income and the unitary production cost of alpaca and llama meat) in three farms groups of Peru and three farm groups of Bolivia.

In the Andean territories the conservation of an agriculture of subsistence is not able to guarantee an adequate life quality for the population. The change of the public politics with the adoption of interventions that gradually directs the agricultural producers toward a market economy able to satisfy the environmental and economic sustainability seems the most suitable choice.

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DECAMA-Project: EVALUATION OF THE CARCASS QUALITY OF ALPACAS AND THEIR CLASSIFICATION

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To develop a system that determines the quality of the carcass of domestic South American camelids and to improve their valuation for their morphology in the market, carcasses of 25 male alpacas of 16 months of age were classified by a subjective method of visual evaluation of the conformation of the leg muscles and the croup. There was a range of five classes: 1) poor, 2) normal, 3) good ,4) very Good, and 5) excellent. The results demonstrated that most of the animals (84 to 96%) were within the classes 2 and 3 (normal). The conformation of the internal profile of the leg in alpacas presented the form of a closed "V" in class 1, and in those of class 3 the profile showed a tendency to form a "Y", with slightly convex muscles. The classification of fat covering considers five regions each with five grades whose results demonstrated that the carcasses presented a scarce development of subcutaneous fat and carcasses classified in classes 3, 4 or 5 were absent.

The indexes of compactness calculated by objective measurement of the ratio between carcass weight / length of carcass, varied between 0.23 to 0.37, the ratio between croup width / length of leg varied between 0.40 to 0.49; the latter one indicated that the alpaca has a more lengthened than compact morphology. The correlations between these indexes and the subjective classification reveal that the most appropriate procedure in qualification is for the croup conformation, which was highly correlated ($r = 0.61$ and 0.57). By multiple regression models were obtained in which the width of the tarsus (measurement F) and width of the croup influenced the weights of leg and loin. The croup width has more influence than the length of the leg on the carcass weight, the same variable influences positively the area of the muscle *Longissimus dorsi*, whereas the length of the carcass has a negative effect on the same muscle ($P < 0.05$).

DFCAMA-PROJECT: EFFECT OF MANUAL DEHAIRING ON THE QUALITY OF LLAMA FIBER

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Until recently, the fiber of llamas had no market value in Bolivia because the textile industry considered it as a very thick fiber (30 - 70 μ) . This situation caused the producers to dehair the fiber in order to commercialize it as alpaca fiber. Actually, various studies were conducted to develop a proper label, because the good physical characteristics of llama fiber received attention in the market. In the llama population a large genetic variation exists (Lauvergne 1999) and three types of llamas were identified: Q'ara (meat type), Tampulli (fiber type) and Intermediates (double purpose) which are differentitated by the fleece structure. The manual dehairing results in increased economic income for the producers.
Different main factors are discussed influencing the quality of llama fiber suchs as: type, age, colour, region and others. The present study revealed that the effect of the manual dehairing is under the influence of three main effects: the age, the type and the region. The age influenced the fiber quality resulting in significant differences ($p < 0.05$) between llamas of one, two or three years. Best fineness was found in the youngest animals (22.63, 22.66 and 23.91 μ, respectively) for undehaired fiber. These means were imporved through the process of manual dehairing resulting in 21.49, 21.27 and 22.91, respectively. The influence of the genotype was significant ($p < 0.05$) with means of 22.76, 23.15 and 23.29 μ for Tampulli, Intermediate and Q'ara animals, respectively (undehaired fiber); after dehairing, the mean fineness was 21.60, 21.95 and 22.12 μ., respectively. The analysis of the percentage of fine fiber showed that the major proportion was found in Q'aras (91.81 %), followed by Tampullis (91.73%) and Intermediates (91.57 %). This result is explained by the double coat of the Q'ara which facilitates the dehairing process.

The environment influences the expression of the genetic potential in that each region has its own genetic variability and environmental characterstics that determine the quality parameters of the fiber. In case studies, different regions were studied: Quetena (wet Puna, "Bofedal") and Tomave (dry Puna). More Tampulli were found in Quetana, followed by Intermediates, whereas in Tomave Intermediates and Q'ara were more abundant than Tampulli. Despite of regional differences, manual dehairing improved the quality of the fiber.

DECAMA-Project: TECHNOLOGICAL AND NUTRITIONAL PARAMETERS OF FRESH MEAT OF ARGENTINEAN LLAMAS (*Lama glama*)

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The objective of this work is the evaluation of color and texture parameters and the quantification of fatty acids and conjugated linoleic acids of fresh meat of Argentinean llamas (Lama glama).The first stage of the research work has been performed with 12 male animals of 21 months old, fed for some time previous to this study in an experimental field located in the La Pampa Province. They were slaughtered according to the methodology used for cattle. Samples of shortloin (*Longisimus dorsi* muscle), "Peceto" (*semitendinus* muscle), "cuadril" (*glueous medium* muscle) were obtained. For the quantification of fatty acids and conjugated linoleic acid (CLA) two grams of fat were extracted from each loin (*Longisimus dorsi* muscle) following the technique described by Folch (1957) and using a methanol/chloroform solution.

The average values obtained from the samples show that the Llama meat (LD) contains 47.80 mg of CLA/100 g of meat, SD ± 8.51. The following fatty acid profile was found in the samples: myristleic acid: 1.93 %, pentatonic acid: 0.94%, palmitic acid: 21, palmitoleic acid: 2.97 %, hexadecadienoic acid: 1.01 %, heptadecenoic acid: 0.43 %, estearic acid: 19.4 %, vaccenic acid: 4.38 %, oleic acid: 24.38 %, linoleic acid: 8.37%, 9 cis, 11 trans-linoleic conjugate CLA, 1.41 %, linolenic acid: 3.72 %, arachidic acid: 0.30 %, eicosadienoic acid: 0.13 %, arachidonic acid: 3.44 %. These results are similar to the ones obtained by Patkowska-Sokola *et al.* (2002) in other ruminant species. The color was measured 48 h post-mortem using a spectrophotometer Minolta CM-508 d using iluminant D65 and a 10° standard. Nine color determinations were made in each samples following the recommendations of the American Meat Science Association for color measurements in meat. Low reflectance glasses were placed between the samples and the equipment. Color parameters were analysed as lightness (L*), redness (a*) and yellowness (b*) and the colour differences (ΔE) of the CIELAB color space. The reflectance spectra, every 10 nm, between 400 and 700 nm were also obtained. The average value of the meat samples indicate that the luminosity (L*) of the "Peceto" was of 34.52 ± 3.61 of the "Cuadril" 31.06 ± 2.40 and of the shortloin 31.82 ± 2.40. The coordinate a* of the "Peceto" was 6.98 ± 1.61, of "Cuadril" 7.35 ± 1.78 and of shortloin 6.73 ± 1.78 . The average values for the coordinate b* in the "Peceto" was 6.99 ± 1.32, in the "Cuadril" 6.4 ± 1.64 and in the shortloin 6.22 ± 1.64. The color differences (ΔE*) for the "Peceto" were 12.76 ± 2.4 , "Cuadril" 12.76 ± 2.44 and shortloin 12.29 ± 2.44. The texture was measured using a TZ-TA-TX2 (texture analyser according to Warner- Bratzler). Each sample was then cut into 10 pieces of 10 x 10 mm x 15 mm (wide x long x thick) parallel to the longitudinal axis of the sample. They were cooked wrapped in aluminium foil in a revolving oven at 200°C till the inner sample temperature reached 70°C. The following average shearing force values were recorded (in pounds): "Peceto" 14.03 SD ± 0.80, cuadril 11.74 ± 1.30 and shortloin 13.11 ± 1.70. In the second stage of this research work (August 2004) meat samples of 25 animals were analysed. A comparison with the previously mentioned values will be carried out, among 25 animals located in Cieneguillas (Jujuy), considering that these animals are under different feeding and productive conditions than in the Province of La Pampa. Thus, it will be possible to evaluate how much these conditions affect the colour and texture of the llama meat.

THE BIOLOGY OF FIBRE PRODUCTION

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Camelids produce commercially important fibres from hair follicles which are embedded in the skin and have close similarities to those of other fibre-producing animals. The fibre product is largely determined by the characteristics of the follicle of origin (Galbraith, 1998). Two types of follicle have been characterised, namely primary follicles which are usually larger and produce fibres which are longer and have a greater diameter than fibres from the more numerous secondary follicles with which they are associated anatomically. Fibres produced by secondary follicles have greater value and animals with high ratios of secondary to primary follicles are generally favoured in breeding programmes.

Studies, particularly in sheep and more recently in mouse have given a fascinating insight into cellular and molecular events of hair follicle morphogenesis (Millar, 2002). Embryonic tissues involved are the mesodermally-produced dermis which interacts, and exchanges chemical signals, with the overlying ectodermally-derived epidermis. The result is a conically-shaped follicular structure of epidermal cells, which extends into the dermis and which has at its base, a small cluster of specialised dermal cells called the dermal papilla (DP). Dermis and epidermis are separated by a continguous basement membrane. The size/volume of the DP affects the number of epidermal fibre-forming cells and hence the diameter of the hair fibre. The DP also has an essential role in determining the fate of the epidermal cells in the follicle bulb. These "keratinocyte" cells divide and depending on their position with respect to the DP differentiate into supporting structures or keratinise into cells of the hair fibre (an incomplete process in the formation of medullated fibres).

The activity and anatomical structure of post-natal follicles vary according to species and location on the body. All follicles are characterised by cycles of fibre growth which differ in length of active growth (anagen) followed by no growth (telogen) in which epidermal cells in the lower bulb matrix have undergone apoptosis (programmed cell death). Regeneration involves the production of a new bulb matrix with existing DP and the shedding of the fibre produced in the previous anagen phase. Influences such a photoperiod (melatonin, prolactin), androgens (5-alpha dihydrotestosterone) and members of a range of growth factor families (eg EGF, FGF, IGF, TGF and receptors) variably act in intercommunication between dermis and epidermis. In addition, signalling pathways involving gene products such as WNT, Sonic hedgehog and FOXN1 are becoming increasingly implicated in regulation of activities such as follicle development, cycling, shape and polarity (angle of the follicle in skin) and epidermal cell differentiation. Other features of follicles may include the presence of pigment-producing melanocytes in the matrix of the bulb.

The paper to be presented will consider the above topics and others including supply of nutrients such as minerals, vitamins and amino acids in influencing rates of keratinocyte proliferation and differentiation and effects on yield and quality of fibre produced.

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DECAMA-Project: PRELIMINARY DATA ON BOLIVIAN LLAMA SKIN FOLLICULAR STRUCTURE

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Thirty llama kids of different sex and type "Q'aras" (or carguera) and "T'amphullis", born between January and April 1998 at the Patacamaya Experimental Station in Bolivia, were chosen for determining the age at which the hair follicles reach the maturity, as well as for comparing the skin follicular structure and activity among these different types of Bolivian llamas.

Skin biopsies were taken from the right mid costal region at 2, 4, 6, 8,10,12 and 14 months of age in order to monitor four follicular parameters: i) ratio of secondary to primary follicles (S/P), ii) percentage of active primary follicles (PAP); and, iii) percentage of active secondary follicles (PAS). The biopsies were immediately fixed in Bouin solution and later dehydrated in a graded ethanol series and embedded in paraffin. Transverse sections of 7 μm were then cut with a rotary microtome and stained by using the Sacpic procedure, modified by Nixon (1993).

As a general trend, the PAP parameter reached a maximum value at the 10^{th} month and a minimum value at the 14^{th} month, while the PAS parameter reached a maximum value at the 8^{th} month and a minimum value at the 4^{th} month. The mean value of the S/P parameter in the Q'aras type was found to be 5.35 with a maximum value reached at the 2^{nd} month, while the minimum value was seen at the 6^{th} month. In the T'amphullis type the mean value was found to be 5.45 with a maximum value at the 4^{th} month and a minimum at the 12^{th}.

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VARIABILITY OF VICUNA FIBRE DIAMETER IN THE PROTECTED NATURAL AREA OF PERU

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Fibre samples from one hundred two younger and older, male and female vicunas were collected during Chaku Festival 2000, in the National Reserve Pampa Galeras – NRPG and National Reserve Salinas y Aguada Blanca – NRSAB, , in order to analize the phenotypic variability of mean, standard deviation and coefficient of variation of the fibre diameter within and between populations. The Sirolan Laserscan method was used to measure the mean fibre diameter of vicuna samples, which were corrected for sex and age effects. Components of variance were estimated using a nested design. The result of mean diameter in both populations were: 13.37 micron (NRPG) and 13.82 micron (NRSAB) ($P<0.05$). The component of variance between populations (σ^2p) was lower than that within and between animals (σ^2_B and σ^2_w), for the mean ($\sigma^2p = 0.09\ \mu^2$, $\sigma^2_B = 0.28\mu^2$ and $\sigma^2_w = 0.27\mu^2$) and the coefficient of variation of fibre diameter ($\sigma^2p = 0.205\ \%^2$, $\sigma^2_B = 0.67\ \%^2$ and $\sigma^2_w = 26{,}9\ \%^2$). The component of variance between animals contributed 45% to all variance of the mean. On the other hand the component of variance within animal contributed 96 % and 97% to all variance of the standard deviation and the coefficient of variation of mean fibre diameter. The genetic variance and permanent environment contributed to the variation in fineness, and special environmental variance influenced the uniformity of vicuna fibre.

DECAMA-Project: WOMEN OF MOUNTAIN IN BUSINESS OF CHARQUE OF LLAMA

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In the population of Lagunas, Oruro - Bolivia, five aymara ladies exist, dedicated to the charque elaboration. With this product they prepare typical plates as the "charquekan" that are marketed in the population of Tambo Quemado (border point with the republic of Chile). In this town, the technique of charque elaboration was precarious and unsanitary: the threaded meat was dried to the bleakness on wooden planks and sticks. To improve the quality of the charque, the Regional Program of South American Camelids (PRORECA) built eolic solar dryers taking advantage of materials of the area, being used as efficient tools for the dehydration of the meat. Starting from this novel construction and the tackle implementation and manual tools, the aymara ladies begin actions of technical and hygienic improvements in the process of charque elaboration. The main function of the solar dryers is to dehydrate the meat in relatively short time and to avoid any contamination of the meat with insects, dust and other agents with impact on the quality of the final product. The implementation of the dryers improved notably the quality of the product and its commercialization, and consequently the quality of the ladies' life.

STUDY OF SETTING UP A NEW NATIONAL ALPACA ENTERPRISE MODEL BASED ON THE UK ALPACA INDUSTRY 1996 – 2004

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Aim of the Study:
To evaluate the success to date of the British alpaca enterprise through comparison with two principle models of the USA and Australia.

Methodology:
By comparison with the two models to study the following:

- The incentive of breeders
- The marketing of the enterprise
- The development of the end use of the fibre
- The infrastructure of support agencies
- The potential future of the industry
- The increase in the alpaca population
- Breeding aims
- The improvements in quality achieved

Possible Conclusions:

- The growth of the alpaca population in the UK, despite Foot and Mouth, demonstrates steady support for the enterprise.
- The initiatives taken in developing the market for fibre show long term goals beyond the 'life-style' and pet ownership aims for breeders.
- The popularity of high quality animals from prestigious overseas herds supports the price structure in the market.
- The steady expansion of the alpaca industry into Europe will bring in a huge new market in which all existing alpaca industries will have an interest.
- The importance of the link between the breeders and the products both for breeding and for marketing.

THE EUROPEAN ENDANGERED SPECIES PROGRAMME (EEP) FOR VICUNAS

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The International Studbook for the Vicuna was started in 1969. It includes all pure bred Vicunas outside the four native countries since 1945. Between 1946 and 1971, 28 Vicunas have been imported from Argentina, Bolivia and Peru. Additional 41 specimens were imported by dealers. The increase from 11 specimens in 1945 to 59 specimens in 1985 therefore is mainly due to these importations. 576 births have been recorded since 1945.

In 1985 the European Endangered species Programme (EEP) was established and the one for the Vicuna was one of the initial programmes. Thanks to this co-ordinated breeding programme the number increased to 163 Vicunas in 34 European and one North American collections in the year 2003. The whole present population belongs to the Southern subspecies *Lama v. vicugna*. Since the number of active founders is only four males and eight females the EEP urgently needs some unrelated specimens. To imitate natural social behaviour groups of one male and two to three females are created. As a consequence there is a surplus of males. In the wild they form large bachelor groups. This proved to be impossible in enclosures of up to 4.000 sqm. Research is needed in this context to enable us to form bachelor groups. Other aspects of reproduction and behaviour resemble the conditions in the wild. The main birth season is August to October (SCHMIDT, 1972 & 1973), a six months transition from the Southern to the Northern hemisphere. Time of birth remains in the morning even in the sixth zoo generation. The breeding male chases out of the group male and female offsprings at an age of six to ten months.

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11.000 YEARS OF CAMELID USE IN THE PUNA OF ATACAMA

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The goal of this paper is to show the changes in the use of camelids through time by analyzing the different modes of relationships between people and camelids (hunting, domestication, and pastoralism).

Two associated processes have been determined between 11,000 and 3000 years B.C. These are: (1) a process of intensification in the use of camelids, and (2) the domestication of the guanaco since *ca.* 4800 B.C. The analysis of the intensification process involved the study of 25 sites in the Southern Andes, allowing us to discern a pattern of increasing utilization of camelids through time. Camelids account for 49% of the utilized species between 11,000 and 8400 B.C., but rise to 83% in the 8400-5000 B.C. period, and increase more between 5000 and 3000 B.C. accounting for 85-100% of the identified species in the archaeological sites. In this last time-span osteological, fiber and contextual evidence showing protection and domestication of camelid populations appear. This process was independent to that occurred in the Central Andes and happened as a consequence of deep social modifications in the hunting-gathering societies of the late Holocene.

After 3000 years B.C. began a process of consolidation of the economies based on pastoralism and agriculture, together with the development of settlement strategies with a more important sedentariness. The camelids represent around 85-95% of the NISP in the sites, in both permanent residential bases ("villages") and transient sites of specific activities. Pastoralism seems to be the most important strategy with the use of a generalized llama type useful at the same time for meat, fiber and as pack animal.

Between 1400 to 500 years B.C. the domesticated camelids turned to more specialized types. Perhaps, in coincidence with the increment of caravan traffic and fiber exploitation, related to an important process of social and political complexity in the Puna societies. Nevertheless, two things are remarkable: 1- hunting of wild camelids remained as a very important activity during all the period between 3000 to 500 years B.C., including Inca's times, and 2- the important cultural changes did not modify the use of different environmental patches in an optimization model aiming at reducing environmental risks.

Posters

SIZE AND GROWTH OF THE GUANACO POPULATION AT CALIPUY NATIONAL RESERVE

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First census of the guanaco populations were realized in June of 2002 and 2003, which reported 462 and 484 guanacos, respectively. These results indicated a population growth of 4.5%. Social structure and sex were observed in each census (do not considering stranger guanacos): in average 36 % of the guanaco population consisted of adults, 5% were young animals, breeding animals were 5%, single males were 25% and single guanaco male group (bachelor) 29%.

The mean of adult females in adult population of each census was 0,84, which to indicates adult females were major than adult males, about five and four. Monthly census at protection areas realised in February 2003 to March 2004, indicated that changed populations were observed between March and May each year. This is related to the birth of "chulengo" and guanaco migrations. These preliminary results indicate that the guanaco population of Calipuy is sustainable for the contribution of major adult female and minor for contribution of breeding. However, it has a gene pool of younger males.

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PRELIMINARY EVALUATION OF THE SUSTAINABLE USE MODULES OF THE VICUÑA IN PERÚ

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The Sustainable Use Modules of the Vicuña (MUS), is a model for sustainable development that involve a progressive capitalization program and technology acquisition by farmers communities (CC) living in the Peruvian Andes holding activities of protection and conservation of the vicuña. The objective of this study is to evaluate the advance in preservation, protection and reasonable approach of the vicuña in 54 farmer communities (CC) in 10 regions of Peru, which had been supported by MUS trough the Rotatory Fond managed by the Department of Agriculture of Peru until 2002.

The applied method consists in three stages: (a) identification and selection of Sustainable Use Communal Committee of Vicuña (CCUSV) which have continually produced vicuña fiber since 2001 to 2003 and had a MUS; (b) collecting information of selected CCUSV; (c) analysis of the data. The information was provided by Regional Offices and processed by the Wild Camelid Program (PCS) of the CONACS.

Number of Captured Vicuñas and Dirty Fiber Production (kg)

Year	N° VICUÑAS		Production of CC with MUS	National Production	Percentage of National Production
	Captured	Sheared			
2001	16,721	7,383	1,495.070	4,332.376	34.5%
2002	22,674	10,218	1,894.046	5,150.176	36.8%
2003	28,026	11,335	2,044.344	6,092.502	33.6%

There is an increase in the vicuña population (68.61%) inside a permanently fenced area (500 to 1000 ha) which is part of the MUS. The number of sheared vicuñas inside the fence was 53.53% of the total population. Those increments were obtained thanks to the governmental protection program and the sustainable use of pastures. The production of dirty vicuña fiber provided by CC represents a third of the total national production that corresponds to an increase of 36.74% in the evaluated period. The volume of fiber produced by the MUS was 5,433.46 kg in the same period evaluated which approximately represents US$ 2'150,000.

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ARGENTINE LEGISLATION IMPACT ON GUANACO EXPORTS

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In the 20th century, guanaco (lama guanicoe) population in Argentina has suffered a drastic disminution. During the last few years, however, legislation aimed at preserving guanacos at wild. On the other hand, legislation ruled over sustainable production on adaptative breeding techniques.

This research will deal with the explanation of export of guanaco products through the main variables.

It shall be herein studied the correlation between exports and the following variables: (1) guanaco abundance, (2) sheep population, (3) climatic conditions, and (4) average prices of guanaco. Furthermore, it shall be analized the actual impact on the legislation for the preservation of guanaco.

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MORPHOLOGICAL VARIATION OF ITALIAN ALPACA POPULATION. I. MENDELIAN AND QUALITATIVE CHARACTERISTICS.

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In order to establish the Stud Book, a morphological characterisation of the alpaca population has been carried out by the Italian Alpaca Breeders Association (ITALPACA). This paper reports the frequencies of some mendelian and qualitative characteristics. Coat colour, type and extension of fleece, skin and hoof colour, ear length and type, and forehead and nose profile were observed in 47 males and 106 females from 17 flocks in North and Central Italy. With regard to the coat colour, 31 % of the animals are full white, 69% pigmented. Regarding the pigmentation patterns, 32% Alpaca are red with black extremities, 32% black, 18% wild, 10% reddish brown, 1% black and tan. Five percent of the animal present an unidentified pattern. Eighty percent of the animals present black eumelanin, 18% brown eumelanin. The alteration of the pigmentation exists in 29 animals: 44% fleece colour are diluted and 56% grey. Twenty percent of animals are spotted, with a variable extension of spotting. About the type of fleece, 47% of animals are classified "Huacaya", 8% "Suri" and 44% are intermediate. Regarding the extension, 94% of the animals present an intermediate fleece extention, 5% of the animals have fleece covering heads and legs and only 1% of animals have uncovered heads, neck, legs and belly. No variation exists for: skin colour (black), hoof colour (black), ear length and type (in both cases normal), forehead and nose profile (straight).

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PATERNITY TESTING USING MICROSATELLITE DNA IN ALPACAS (*Vicugna pacos*)

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Ten alpaca and llama microsatellites (Lang *et al.*, 1996; Penedo *et al.*, 1998) were used to evaluate paternity in 47 alpacas registered at the IVITA Research Station in Maranganí, Canchis Province (Cusco – Perú). The microsatellites were amplified in three multiplex reactions and were polymorphic for all samples. Allele numbers varied between 4 and 20, and both allelic frequencies and exclusion probabilities were calculated using Cervus 2.0. All loci, except two, were within the range published by Lang *et al.* (1996) and Penedo *et al.* (1998). The accumulated exclusion probability for the ten loci was 0.9998, and for each multiplex reaction the accumulated exclusion probability was greater than 0.90. The results confirmed paternity in 18 parent-offspring pairs, but in a further 4 cases different adults were identified as parents than those recorded in the registry, demonstrating the necessity of DNA testing to insure accurate recordkeeping and guarantee the parentage of registered animals.

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MORPHOLOGICAL VARIATION OF ITALIAN ALPACA POPULATION. II. BIOMETRIC CHARACTERISTICS

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In order to establish the Stud Book, a morphological characterisation of the alpaca population has been carried out by the Italian Alpaca Breeders Association (ITALPACA). Biometrical characteristics have been recorded in 47 males and 106 females at different ages by the 17 ITALPACA members. The measures are: rump width, withers and chest height. A factorial model with age (7 levels), sex (2 levels), farm (4 levels) and South American origin (3 levels) as factors has been used for the analysis of variance, according to SAS GLM procedure. Phenotypic correlations have been estimated by the SAS CORR procedure. Only the age effects were significant for the three measurements. The estimated means for the age are presented.

Estimated means for age of the animals.

Age (Years)	Withers height (cm) $\bar{x} \pm sd$	Chest height (cm) $\bar{x} \pm sd$	Rump width (cm) $\bar{x} \pm sd$
2	82.318 ± 2.351	32.597 ± 1.162	19.345 ± 1.304
3	85.065 ± 2.427	34.232 ± 1.199	21.965 ± 1.346
4	84.057 ± 3.238	34.387 ± 1.600	21.212 ± 1.796
6	89.670 ± 2.485	36.871 ± 1.228	22.798 ± 1.378
7	83.087 ± 2.271	35.386 ± 1.122	22.057 ± 1.260
8	84.598 ± 3.226	34.567 ± 1.594	22.319 ± 1.789
9	76.057 ± 4.662	31.387 ± 2.304	18.212 ± 2.586

Withers height, chest height and rump width are significantly positively correlated. The coefficients of correlation are very high: 0.543 for withers and chest height, 0.375 for withers height and rump width, 0.457 for chest height and rump width.

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REFERRAL SERVICE FOR SOUTH AMERICAN CAMELIDS AT THE UNIVERSITY OF BRISTOL VETERINARY SCHOOL: A REVIEW OF CASES FROM 1999 TO 2002

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South American or New World camelids are increasingly important species outside of South America. Britain is home to one of the largest population of New World camelids in Europe, estimated at 4-5000 individual llamas and 7-8000 alpacas. Knowledge in the field of veterinary medicine gained on the more common species, the llama and the alpaca could be transferred to the less common ones, the guanaco and vicuña.

As a result of increasing numbers of camelids referred, and the rising number of inquiries from private veterinary practitioners, a new Residency in camelid medicine was created, thanks to a joint effort between the University of Bristol and the Royal College of Veterinary Surgeons Trust.

Seventy-four individual clinical cases, from February 1999 to December 2002 were admitted. Of this, sixty-five were alpacas (88 per cent) and 9 llamas (12 per cent). Out of the total number of cases referred, fifty-five were females (74 per cent) and nineteen were males (26 per cent). Crias (unweaned animals), often below 6 months of age) represented thirty-two per cent (24/74) of the animals admitted. Based on aetiology, body system and pathological process involved, thirty-one different diagnoses were formulated.

The telephone advisory service and distance referrals have taken a significant portion of the time allocated by the authors to camelid medicine. Since records begun (March 2001), the referral service received thirty-nine different, individual and group clinical case reports from veterinarians in private practice, and a total of sixty-three general enquiries on camelids health.

This poster provides a descriptive summary of clinical and surgical camelids cases (second opinion) referred to the Farm Animal Practice & Hospital (FAPH) of the University of Bristol, and the associated experience of first opinion cases as well as distance referrals..

BREEDING AND/OR HANDLING PROBLEMS? CAUSES OF DEATH IN CAMELIDS

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During the last 10 years the number of owners of camelids has grown constantly. Due to a lack of information about the handling, feeding and breeding of these animals numerous problems resulted, which in some cases even caused the death of these animals. Supported by the „Institute of Veterinary Pathology of the University of Munich", post mortem examination in 180 camelids were performed between 1993 and 2003. In addition, the results of 42 post-mortem examinations of other institutes and laboratories were added which were supplied by camelid owners. This evaluation includes 144 llamas, 63 alpacas, 5 guanacos, 1 guanaco-llama mix, 5 dromedars, 3 camels and one vicuna.

The results of the post-mortem examinations were divided in:

- Diseases of:
  the head, the neck, the thorax (heart and lung), the abdomen, the digestive system, the urinary tract, the spleen, the genitalia, the skin, the limbs, the bones
- Causes of death

The evaluation showed that most pathological changes were found in the thorax (62.2 %). The reason for this predominance is a pulmonary edema which develops as a consequence of cardiovascular failure during the process of dying. Apart from this the most frequent problems were found in the liver (48.6 %), the digestive system (43.2 %), and the abdomen (36.0 %), caused by endoparasites, infections, and chronic feeding faults. Further pathological problems were found in the urinary tract (31.5 %), the head (26.6 %), the spleen (23.0 %) and the skin (22.5 %). The reasons were parenchymatous degeneration, teeth problems, spleen reactions and mites, or infections, respectively. Less frequent were pathological situations in the genitalia (14.0 %), the neck (10.4 %), the bones (9.0 %) and the limbs (6.3 %). Two or more reactions in one animal had been found, so the summed percentages exceed 100 %. The death reasons found in this investigation were primarily infectuous diseases (22.5 %), euthanasia (17.1 %), emaciation (9.5 %), and fatty degeneration of parenchyma (9.0 %). In 14.4 % of the cases the diagnosis was inconclusive.

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EMBRYO MORTALITY AND ITS RELATION WITH THE PHASE OF FOLLICULAR DEVELOPMENT AT MATING IN ALPACA

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Embryo mortality is an important factor that affects the reproductive performance of alpacas under Peruvian condition. Alpacas as other camelids are induced ovulators and mating is required to induce ovulation. A wave pattern of follicular development was reported in alpacas using laparoscopic techniques and in llamas with the use of ultrasound technique. Pattern of follicular growth with a phase of growth, maintenance and regression of the largest (apparently dominant) follicle required an average of 4 days for each phase (total of 12 days) and females can accept mating in all phases when folliclar size is ≥ 7 mm. Knowledge of follicle status during mating may be useful to explain some factors related with embryo mortality in alpacas. The objective of this study was to compare the follicular phase status during mating (growth, maintenance or regression) with embryo mortality at day 35-post mating.

116 alpacas, ≥3 years of age, were examined once daily with an ultrasound equipment ALOKA SSD 500 and probe of 7.5 MHz to evaluate follicular dynamics and then assigned to the following groups G1: Growing follicle 5 – 6 mm (n = 27); G2: Growing ≥ 7 mm (n=30); G3 Maintenance ≥ 7 mm (n = 30); G4 Regressing follicle ≥7 mm (n= 29). Ultrasounds examinations were performed on days 0, 3, 9, 20, 25, 30, and 35 to determine occurrence of ovulation (day 3), corpus luteum diameter (CL (day 9) and presence of embryonic vesicle or embryo (between day 20 to 35). Male acceptance, ovulation and conception rate was compared by Chi Square analysis between groups.

Acceptance rate was 100 % in groups with growing, maintenance and regressing follicle but 81.5 % of animals with follicle of 5 – 6 mm accepted mating. Ovulation rate was 95.45, 96.67, 100.0 and 96.55 % in G1, G2, G3 and G4, respectively ($P > 0.05$) and no differences were detected between groups in CL diameter. Conception rate on day 20 was 57.1, 68.9, 60.0 and 50.0 % for G1, G2, G3 and G4 ($P > 0.05$). Embryonic loss rates from day 20 to day 35 were not significantly different between groups.

These results suggest that the status of follicular development at mating would not influence on embryo mortality rate between day 20 and 35 of gestation in alpacas and that animals that accepted mating in all phases, including the one with follicle of 6 mm diameter present a similar reproductive performance. Other factors than follicular size and status at mating should be involved with embryo mortality in alpacas.

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EFFECT OF OESTRADIOL ON EMBRYO MORTALITY IN LLAMAS

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Embryo mortality is an important factor that affects the reproductive performance of camelids under Peruvian conditions. Maternal recognition of pregnancy would be an important factor involved in the embryo mortality of camelids. The objective of this study was to evaluate the effect of application of oestradiol and progesterone on day 8 and 9 after mating on the embryo survival from day 20 to 35 in llamas.

80 adults female llamas were used. Animals were evaluated with an ultrasound equipment ALOKA SSD500 and probe of 7.5 MHz to determine presence of a dominant follicle ≥ 7.0 mm and then mated with males. After mating the animals were assigned randomly to the following groups G1 (n = 20, Control) : 2 ml IM saline solution on day 8 and 9, G2 (n = 20) : 0.2 ml, oestradiol day 8 and 9 after mating, G3 (n= 20) : 15 mg progesterone day 8 and 9 after mating, G4 (n = 20): 0.2 mg oestradiol and 15 mg progesterone day 8 and 9 after mating. Ultrasound examinations were performed on days 0, 3, 9, 20, 25, 30, and 35 to determine occurance of ovulation (day 3), corpus luteum diameter (CL (day 9) and presence of embryonic vesicle or embryo (between day 20 to 35). Male acceptance, ovulation and conception rate was compared by Chi Square analysis between groups.

Acceptance rate to males was 100 % in all groups and ovulation rate was 95, 100, 95 and 100 % in G1, G2, G3 and G4, respectively ($P > 0.05$) and no differences were detected between groups in CL diameter. Conception rate on day 20 was 57.9, 75.0, 63.1 and 55.0 % to G1, G2, G3 and G4 ($P > 0.05$). Embryonic loss rates from day 20 to day 35 were not significantly different between groups. These results suggest that oestradiol has a positive effect on embryonic survival and would be a factor involved in the maternal recognition of pregnancy. More research is necessary to determine the role of oestradiol and its effect on embryo mortality in llamas.

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BIOLOGY OF *EIMERIA MACUSANIENSIS* IN LLAMAS

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Eimeria macusaniensis is a parasite of the small intestine of South American camelids. Knowledge on its biology is very scanty. The present studies were performed to obtain first substantial data on the epidemiology and life cycle of this protozoon.

Course of natural infection: The pattern of *E. macusaniensis* oocyst shedding was studied in llamas of a large farm in central Germany by faecal examinations in monthly intervals during a 12-month period. Foals started the oocyst shedding in the 2nd month of life showing highest prevalence (67–71%) and maximum oocyst counts per gram faeces (OPG) (400–450 OPG in mean) 2–3 months post partum; from month 8 post partum less than 5% of the foals shed oocysts. In dams and male yearlings the prevalence of the infection (maximum: 16% and 26%, respectively) and oocyst counts (mean: 24 OPG and 45 OPG, respectively) was distinctly lower than in foals during the study.

Sporulation time: *E. macusaniensis* oocysts were isolated from fresh faecal samples and incubated in 2% potassium dichromate solution at temperatures of 6–7, 18–19, 25 or 30 °C. Maximum sporulation rates (92–94%) were obtained at 18–19 or 25 °C on day 21 and at 30 °C on day 13. The oocysts did not sporulated at 6–7 °C.

Prepatent and patent period: Six llama foals reared parasite-free were orally infected with $2x10^4$ (n=5; one month old) or $1x10^5$ (n=1; two months old) sporulated oocysts of *E. macusaniensis*. The prepatent period was 32–36 days and the patent period 39–43 days. The total oocyst output (500–1300 OPG in maximum) was $3.3–10x10^6$ and the mean reproductive rate 1:310 after the initial infection. Reinfections with $5x10^4$ oocysts 2 or 3 weeks after the end of the first patency resulted in a longer prepatent period (37–40 days), a shortened patent period (20–23 days) and reduced oocyst output (mean reproductive rate 1:125) indicating a immune response to the first infection.

CHANGES IN TESTICULAR HISTOLOGY AND SPERM QUALITY IN LLAMAS (*Lama glama*) FOLLOWING EXPOSURE TO HIGH AMBIENT TEMPERATURE

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High environmental temperature can cause heat stress and infertility in male llamas. Reduced fertility of males during the summer is described (FOWLER, 1998). Even under middle European climatic conditions seasonal changes in sperm parameters were detected. Sperm concentration was negatively correlated with the environmental temperature (GAULY, 1997). The objective of the present study was to demonstrate the changes in testicular histology and in mitotic activity of spermatogonia following a constant high ambient temperature under experimental conditions, corresponding to the changes in semen parameters in llamas.

For this study three fertile male llamas were castrated and were kept as control group. Ten fertile male llamas were housed in heated stables. After one of week acclimatisation period, the ambient temperature was elevated up to 30°C for 4 weeks. Afterwards the animals were allowed to recover for at least 7 weeks at 20°C. Semen was collected once a week from 4 animals using an artificial vagina and a phantom as mounting partner. Standard semen parameters were recorded each time. Six of the experimental animals were castrated at different times during the experiment (directly, two, four and 6 weeks after the heat period) to evaluate the histological changes in the testes. A staining with haematoxillin and eosin for microscopic study was performed. Using monoclonal antibodies (MIB-1) against the proliferation marker Ki-67 protein, the quantitative distribution pattern in the seminiferous epithelium of llamas was studied, in order to investigate the mitotic activity of the spermatogonia at different times after heat exposure.The testes of animals castrated directly after the heat-period showed a general disorganization of the seminiferous epithelium consisting of the absence or reduction in number of various generations of germ cells, resulting in an increase of tubules cross sections where no stage could be determined. Six weeks after the heat-period the histological findings were still different compared to the control group. In the control group 36.9±7.6% of the spermatogonia were Ki-67 positive, e.g. were proliferating. Within the experiment the percentage of proliferating spermatogonia decreased to 8.2±5.8% two weeks after the heat-period. Four weeks after the heat-period the number of proliferating spermatogonia recovered to the levels of the control group. The sperm concentration declined significantly in all animals after the heat-period, the minimum level being reached 4 weeks after heat exposure with the percentage of abnormal sperms decreasing simultaneously.

High ambient temperatures can lead to significant changes in testicular histology and sperm quality in llamas and can result in infertility of the males.

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SEROPREVALENCE OF *NEOSPORA CANINUM* UND *TOXOPLASMA GONDII* IN SOUTH AMERICAN CAMELIDS

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Neospora caninum is a cyst-forming sporozoan parasite that has the dog as a definitive host and probably a wide range of animals as intermediate hosts. It is currently regarded as one of the most important causes of abortion in cattle worldwide. However, nothing is known about its possible presence in South American camelids (SAC) until now. The aim of the present studies was to collect first data on this topic.

Experimental infection: A llama yearling being seronegative for *N. caninum* and *Toxoplasma gondii* before inoculation was inoculated i.v. with 4.8×10^6 cell culture *N. caninum* tachyzoites. Serum samples were collected twice a week after inoculation and examined by western blot for antibodies against immunodominant *N. caninum* tachyzoite antigens (IDAs) of 17, 29, 30, 33 and 37 kDa molecular weight. The llama developed antibodies against two of the IDAs as early as 12 days p.i. and against all five IDAs later on. In contrast, the control animal inoculated with cell culture medium remained serologically negative.

Seroprevalence survey: Serum samples were collected from a total of 869 young (3–6 months of age) and adult SAC of two farms in Peru (Department Puno) and from 32 SAC of a farm in central Germany. The sera were examined by western blot for antibodies against *N. caninum* and *Toxoplasma gondii*. The results from Peru are presented in the table. On the German farm one of 13 foals and 14 of 19 adult alpacas and llamas were seropositive for *T. gondii*, but no reactions with *N. caninum* IDAs were observed in any of these animals.

Seroprevalence (immunoblot) of *N. caninum* and *T. gondii* in SAC from Peru.

			Total	Seropositive for *N. caninum*		Seropositive for *T. gondii*	
Origin	Host	Group	n	n	%	n	%
Malkini	Alpaca	Foals	195	5	2.6	2	0.5
Quimsachata	Alpaca	Foals	161	1	0.6	1	0.6
		Adults	319	10	3.1	17	5.3
	Llama	Adults	81	1	1.2	7	8.6
	Vicuna	Adults	113	0	0	3	2.7

Our results indicate that at least a low proportion of SAC living in this particular region of Peru has been exposed to *N. caninum*. The higher seroprevalences of both *N. caninum* and *T. gondii* in adult SAC than in foals suggest a predominance of postnatal routes of infection. The clinical significance of these findings remains to be investigated.

DETERMINATION OF INTERNAL ORGAN WEIGHTS IN LLAMAS AND ALPACAS

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To investigate whether there were species or gender differences among organ weights in adult camelids, the first and second gastric compartments (forestomach), third gastric compartment, liver, and pancreas were collected post mortem from 2 female and 6 male alpacas and from 16 female and 7 male llamas and were weighed. These camelids all were euthanized for reasons independent of this project. Organ weights, and organ weights as a proportion of total live body weight or forestomach weight were calculated and compared between camelids of different species and genders. No gender differences were found. Llamas had proportionally larger forestomach and smaller third gastric compartments, livers, and pancreases than alpacas. The ratio of pancreatic weight to forestomach weight was also greater in alpacas, whereas the ratio of pancreatic weight to hepatic weight was not different between species. These findings suggest that the forestomach compartment makes up a greater proportion and soft tissue a smaller proportion of total body weight in llama. This may affect factors such as medication dosages. These findings also suggest that camelids have a similar pancreatic mass to ruminants, which makes it unlikely that lack of islet cell mass is responsible for the relative lack of insulin production in camelids.

DECAMA-Project: THE MODEL SLAUGHTERHOUSE OF CAMELIDS OF PALCOCO, LA PAZ, BOLIVIA

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The slaughter of llamas and alpacas in the region of the highland of La Paz-Bolivia is carried out in precarious form, this process is very far from fulfilling the norms of quality and hygiene of the Bolivian Institute of Normalization and Quality (IBNORCA).

However, in the town of Palcoco, La Paz, Bolivia, by means of a donation of the International Fund of Agricultural Development (FIDA), the Regional Fund of Appropriate technologies in Conservation and Sustainable Handling of Natural resources (FONRENA) and the technical support services and administrative of the Regional Program of South American Camélids (PRORECA), an association of producers named ACOPROCCA, implemented a model slaughterhouse for slaughter of llamas and alpacas that responds to the demands of Certification and Norms settled down by the Bolivian Institute of Normalization and Quality (IBNORCA). The capacity of the slaughterhouse is of 25 heads per day.

DECAMA-Project: ANALYSIS OF THE FACTORS THAT CONDITION THE PRODUCTION OF LLAMA MEAT IN THE PUNA OF JUJUY: STUDIES OF CASES IN THE HUMID PUNA AND THE DRY PUNA

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The Puna of the Province of Jujuy is the argentinean region that concentrates the major quantity of lamas of this country. This territory of 2,934,500 hectares (with 1,745,071 hectares of surface of explotation) possesses 176,775 heads of lamas that constitute one of the principal natural economic resources of the region, nevertheless their grazing is not exclusive since they share the habitat with sheep, goats and cattle.

In this context, the production of fiber has been well established. On the contrary, the production and marketing of lama meat has not had the same pace of evolution.

In this respect we can identify environmental, economic, management and cultural factors that determine this development. The main object of this work is to analyze, from the point of view of the production of lama meat, which are these factors, since they influence the production and marketing of meat and which are the perspectives of this production activity.

With this aim two zones of the Puna have been considered as cases of study: the region of the Cuenca Pozuelos's North with Cieneguillas's community (Humid Puna) and the region of the Cuenca of the Big Rio of San Juan with Cusi Cusi's locality as central population (Dry Puna).

The methodology of the work has included cattle censuses, studies of the representative farming activities, climatic and environmental data

DECAMA-Project: YIELD AND QUALITY OF DEHAIRED LLAMA FIBER OF THE COMMUNITY OF PHUJRATA

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Fiftyone llama fleeces obtained from the community of Phujrata of the Department of La Paz, Bolivia, were divided into two groups: in the first group a complete manual dehairing was applied and in the second a partial manual dehairing, by means of the tactile-visual method based on fibre fineness and longitude. They were classified in five categories of quality: AA: First, A: Second, SK: Briefs or claw, LP: Locks/Pieces and CD: Thick hairs. For each category, the diameter, medullation percentage and the fiber longitude were analyzed before and after the dehairing. The effect of the qualities showed statistically siginifcant differences ($P < 0.01$) for the characters studied. In the fleeces of Phujrata it was observed that the effects of the dehairing and the classification in quality categories were highly significant ($P < 0.01$) for the diameter, medullation and longitude, and the treatment affected statistically significant ($P < 0.01$) the fiber diameter, but not the medullation percentage and longitude. The yields of dehaired and classified fiber of fleeces of Phujrata were 47.23, 18.39, 9.85, 14.89, and 7.89 %, respectively for the qualities studied. The dehairing of white fleeces of Phujrata was more time consuming than that of the colored fleeces. In the fleeces of the community of Phujrata, the partially dehaired fleeces resulted in higher economic benefits than the completely dehaired.

DECAMA-Project: SUPPLY AND DEMAND CHARACTERISTICS OF ALPACA MEAT AND CHARQUI

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The present study examines the operation of the market of meat and charqui from South American camelids (SAC) in Peru and considers the following objectives: a) to analyze the camelids subsector´s evolution as a part of the Peruvian cattle sector, and b) to determine the supply and demand characteristics of SAC´s meat and charqui. The analysis of changes in the cattle sector structure is based on secondary data of the Peruvian Ministry of Agriculture. The second component takes into consideration primary data mainly, which was obtained by surveys published in a Master thesis (PACHAO, 2003).

The economic theory has developed criteria for the analysis of commercialization processes and their influence in the dynamics of the supply as demand of a product.

The present research revealed that the camelids´ subsector within the agrarian sector has undergone a reduction, specially in cattle, due to the increase of the poultry meat production. This latter has grown by 8.64% in annual volume of production, becoming the main protein source for the Peruvian population; whereas the camelids´ subsector (meat) has annually decreased by 1.18% during the 1990-2000 decade.

The analyses of the causes of this development allows us to identify the meat (12,22 MlsTM/year) and charqui (443,4 TM/year) supply difficulties. Among the main problems is that there is not supply organization, basically due to the size of producers which causes supply´ s inelasticity. And, in the case of charqui, its high production costs, due to the percentage of losses and the lack of secondary activities in the rural area.

With respect to the demand, we identify the consumers´ lack of motivation because the nutritional values for both products are not known. There exists demand of charqui in both the urban and the rural areas; in the first, the demand reaches at the most 30% of the population while in the second it reaches 64% of the population. Both products are distributed by traditional processes of commercialization. Without greater participation of the meat and charqui producers, other agents obtain greater importance in setting the final price to the consumers.

The research concludes first, that the camelids´ meat subsector has been loosing dynamic against other meat products and second, that there is stagnation in the case of charqui. This is because the market agents: producers and consumers are subject to adverse commercial relations in the case of the first, whereas for the second, the main reason is the lack of modern channels of commercialization that stimulate the demand of such products, recognizing them as nutritional, healthy and elaborated with high standards of production.

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AN EVALUATION OF THE GROWTH AND CHANGE IN BODY DIMENSIONS FROM BIRTH TO MATURITY OF THE LLAMA (*Lama glama*) AND THE HUARIZO (CROSSBRED CAMELID) IN THE BOLIVIAN ANDES

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The development of 25 llamas and 5 huarizos (llama - alpaca cross) was evaluated for body weight, height, length, chest circumference and staple length from birth to 900 days of age, at the Patacamaya Experimental Station in La Paz, Bolivia. The llamas were significantly heavier than the huarizos at all ages. The overall growth pattern for both genotypes was described as a nonlinear mixed growth curve model and as a quadratic function of age. The llamas tended to be taller with larger chest circumference than the huarizos, but they were not always significantly different. There appears to be no difference in body length. The huarizos produced significantly longer staple length than the llamas. The results from the llamas were similar to other South American studies but smaller than those obtained in North American.

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SUPPORT OF THE HIGH LAND ALPACA BREEDERS BY THE PROALPACA PROJECT

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A study was made to evaluate the support of the Proalpaca Project to those families living in the lowest development levels of high lands (over 3,800 meters) in the central Peruvian's Andes, in order to increase the alpaca fiber production. The project, which is an initiative of the Consejo Nacional de Camélidos Sudamericanos (CONACS) and is financed by the Peruvian State and the European Community, includes 12,000 families and 600,000 alpacas. The families are organised in farmer's communities, which allow them to access the necessary natural resources to keep their alpaca breeding and achieve social representation in content with the local, regional and national authorities.

The project develops two kinds of actions: a) Provision of infrastructure and productive equipment and b) Technical assistance and qualification. To make these actions possible, the project promotes the organisation of the producers in management communal committees, which provide the infrastructure and productive equipment support, given by the Project. The local operators (development private institutions hired by the Project) accomplish the technical assistance and the qualifications of alpaca rising families in all stages of alpaca breeding and also in the commercialisation of the products (fiber, meat, skin). 40% of the Project investment is reimbursable. The management communal committee is in charge of the Alpaca breeding reinvestment fond in each community that participates.

This study consisted in evaluation of regional information about Project achievements until 2003.

Proalpaca Project has achieved, through fortification of the alpaca fiber productive chain (offer of organisation, equipment and technical assistance in efficient methods of shearing), an increase of 40% in the incomes obtained for fiber sale. As well, the project has achieved through fortification of the alpaca meat productive chain (organisation and qualification of families for commercial management, rating and improvement of slaughter centers, as well as promotion and diffusion of products), a significant increase of alpaca meat acceptation in the most important markets of Lima city. Finally, the Project has achieved, through the fortification of capacities (courses and seminars), agreements with the local governments to execute productive and infrastructure projects inside the alpaca sector, with an investment of one million dollars for the next three years.

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