Issue 6 August 2012

NEWSLETTER of the LowInputBreeds project

Development of integrated livestock breeding and management strategies to improve animal health, product quality and performance in European organic and 'low input' milk, meat and egg production

Editorial

Dear Readers,

This 6th newsletter of the LowInputBreeds project is quite a lengthy document reporting on the second Symposium of the LowInputBreeds project, which was held in Hammamet, Tunisia, in May 2012. This issue serves as proceedings of the papers presented as well as progress reports on the four species-specific subprojects of LowInputBreeds, which were also presented in Hammamet.

The second LowInputBreeds Symposium was held together with the 14th International Seminar of the FAO-CIHEAM Network on Sheep and Goats, Sub-Network on Nutrition. The seminar was entitled "Feeding and management strategies to improve livestock productivity, welfare and product quality under climate change".

The LowInputBreeds partners are very grateful to the National Institute of Agricultural Research of Tunisia (INRAT), and in particular to Dr. Hichem Ben Salem for hosting this very well organised seminar and for having made it possible to accommodate the LowInputBreeds Symposium.

Veronika Maurer, scientific coordinator and

Gillian Butler, coordinator

Contents

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Background and progress reports from the subprojects

Subproject 1: Dairy cow production systems[1]

Gillian Butler[2]

Structure and aims of the subproject

In many areas of Europe economic pressures have resulted in a significant increase in herd sizes in 'low input', grazing-based systems. These changes have resulted in reduced management input per cow, accompanied by an increased disease risk and fertility problems. Improvements in management have to be accompanied by suitable breeding programs, which are highly cost-efficient and sustainable. The objectives of this subproject are:

- The development of within breed selection systems to improve animal health, product quality and performance; comparing genome-wide and traditional quantitative-genetic selection (work package 1.1)
- Assessing cross breeding strategies to optimize the balance between 'robustness' and performance; comparing cross-breed cows with pure bred Holstein Friesian cows (work package 1.2)
- The design of optimized breeding and management for different regions of Europe; model-based multi-criteria evaluation considering performance, animal health and welfare, product quality and environmental impact (work package 1.3).

Summary of results obtained so far

In work package1.1 (Development of within breed selection systems), approximately 1800 Swiss Brown dairy cows from 40 low input farms have been extensively assessed for a wide variety of traits related to health, fitness, behaviour, and product quality. Variance components and breeding values were estimated for all traits taking account of full pedigree. The resulting breeding values along with the corresponding reliabilities will be the basis to develop a genomic breeding value estimation for traits relevant in low input production systems. During the farm visits, milk and blood samples were taken to assess the fatty acid profile of the milk and to extract DNA for SNP genotyping (SNP = Single Nucleotide Polymorphism). In total, 833 animals (775 cows, 58 bulls) are genotyped with a high density SNP array (~777 K SNP). We also have access to 2260 animals genotyped with the 54 K SNP array, so that in total 3093 genotyped animals are available to develop a genomic model.

In work package1.2 (Development of improved cross breeding strategies to optimise the balance between 'robustness' and performance traits), the start of sampling and monitoring crossbreed cows under extensive management was delayed until a small pilot study confirmed milk samples collected for routine milk recording (preserved with bronopol) could be used to assess fatty acid composition. As a result, although sampling is almost half way through, no data analysis of has been carried out. On the other hand, an oilseed supplementation trial was carried out earlier than planned. In this study linseed was fed to dairy cows under organic and conventional indoor management in winter. Higher concentrations of beneficial unsaturated fatty acids, such as c9t11 conjugated linoleic acid, oleic acid, vaccenic acid and α-linolenic were found in milk after linseed supplementation, as well as organic feeding. Organic cows also produced a greater increase in some beneficial fatty acid concentrations after oilseed supplementation.

In work package1.3 (Design of optimised breeding and management systems for different macro climatic regions of Europe), genetic parameters were estimated for a wide variety of longitudinal traits using random regression models. These parameters will serve as inputs for a population simulation program,

[1] The work packages of subproject 1 'dairy and beef cattle production systems' are:

Work package 1.1 Development of within breed selection systems to improve animal health, product quality and performance traits; comparing genome-wide and traditional quantitative-genetic selection

Work package 1.2 Development of improved cross breeding strategies to optimise the balance between 'robustness' and performance traits; comparing cross-breeds with pure-bred Holstein Friesian genotypes

Work package 1.3 Design of optimised breeding and management systems for different macro-climatic regions of Europe; model-based multi-criteria evaluation with respect to performance, animal health and welfare, product quality and environmental impact

[2] Gillian Butler, Nafferton Ecological Farming Group, University of Newcastle, King George VI Building, Newcastle upon Tyne. NE1 7RU

allowing us to assess the complex interdependencies between all relevant metabolic traits in the dairy cow, both on the individual and the herd level. The simulation software QMSIM was further developed to allow the analysis of scenarios relevant in low input breeding systems. A first study entitled 'Assessing the Impact of Natural Service Sires and Genotype by Environment Interactions on Genetic Gain and Inbreeding in Genomic Breeding Programs' is ready to be submitted for publication. In addition to these activities, three new partners from Ireland, Slovakia and Italy were recruited via an open call, which will enhance the available data base, especially with respect to traits related to beef performance in dairy production systems.

Plans for the remaining 2 years

In work package1.1, all genotypes will be imputed ensuring the full HD genotype is available for all animals. This will allow us to assess the *haplotype inventory* of the Brown Swiss, which can also be used to identify genomic regions with signatures of recent positive selection, which might be typical for the adaptation to low input production systems. Estimated conventional breeding values will be *deregressed* and used to train genomic prediction models using a variety of approaches (genomic BLUP, Bayes B, Kernel methods etc.). The accuracy of genomic prediction will be assessed via cross validation. An optimized genome-based breeding scheme for low input dairy production system will be derived using the empirical accuracies obtained.

In work package1.2, another 2 sampling dates have to be completed for the study on crossbreed cows under organic and low input management; scheduled for July and September/October 2012. On each occasion, detailed records on udder and feet health, fertility, milk quality and feed inputs along with milk samples are collected from approximately 1000 individual cows over a range of breed combinations, with the idea of comparing different crosses on each farm. In addition, another feed trial has just been completed - using rapeseed and/or naked oats as lipid supplements for organic and conventional cows over 10 weeks, with the impact on fertility, health and milk quality still to be assessed.

In work package1.3, parameter estimation and herd simulation will be applied with data from a wider variety of macro-climatic zones across Europe. A special focus will be on the environmental impact of production systems by including traits like greenhouse gas emissions and feed efficiency. This will be partly based on results obtained in collaboration with the three new partners, providing access to a wider data base and trait spectrum.

Pictures: Phenotyping cows.
All photographs: Thomas Alföldi, FiBL

Discussion with the farmer – some of the information collected is based on the farmers' knowledge

Others like back fat thickness or body condition score are measured on the cows

On the pasture certain aspects are looked at like the temperament of the cows

Subproject 2: Sheep production systems[1]

Hervé Hoste[2,3] Smaro Sotiraki[4], Alekios Stefanakis[5], Veronika Maurer[6], Felix Heckendorn[7], Steffen Werne[8], Sophie Prache[9], Joel Ballet[10], Alessandro Priolo[11], Valentina Vasta[12], John Hickford[13], Carlo Leifert[14], Gillian Butler[15]

The general aim of the LowInputBreeds project is to develop integrated livestock breeding and management strategies to improve animal health and the product quality and performance in Europe in cattle, sheep, pigs and poultry. Within this frame, studies in the sheep subproject (SP2) focus on production in mountainous and Mediterranean conditions, examining both meat and milk production. Five main institutions are involved: FiBL (Switzerland), INRA (France); NAGREF (Greece); University of Catania (Italy) and the University of Lincoln (New Zealand). The overall objective is to examine how the separate manipulation and then integration of genetic and/or environmental (nutrition and grazing management) components in production systems might reduce reliance on chemical inputs and improve the animal response to stress as well as assessing the consequences on performances and milk/meat quality. The response to two types of stress has been explored; one abiotic (heat stress), the other biotic [parasitic infections of gastro intestinal nematodes (GIN)]. The consequences of such integration on both ethics and economics of sheep production, will be evaluated within horizontal activities of the project (work packages 5.1 and 5.2).

The impact **of genetic components** on the stress response and product quality of is being examined either within a breed in a Greek dairy sheep system of production or between 2 meat producing breeds in Switzerland. Records of individual animal response to stress as well as the characterization of the quality of products (Task 1) is nearly completed in both systems (work packages 2.1.1 and 2.2.3) and is being analysed. The second step, to evaluate genetic performance and functional traits in dairy sheep in Greece, is in progress. A third objective includes evaluating the potential of individual genotyping; relying on molecular markers designed in New Zealand to select sheep for their response to stress and product quality. This task will start by assessing heterogeneity of molecular markers in 5 sheep breeds in different European conditions (Skakiano sheep in Greece, Engadine and White Alpine breed in Switzerland, Limousine and Blanche du Massif Central breed in France). Unfortunately unexpected events, (two successive earthquakes!) have affected colleagues in New Zealand and scheduled analyses have been postponed.

[1] The work packages of subproject 2, sheep production systems:

Work package 2.1 Development of within breed selection systems to improve abiotic and biotic stress resistance and performance traits; comparing marker assisted and traditional quantitative-genetic selection systems for functional traits.

Work package 2.2 Development of improved endoparasite management strategies based on integrating (a) feed supplementation with tanniniferous forages with (b) strategic use of clean pastures and/or (c) the use of parasite tolerant breeds.

Work package 2.3 Development of strategies to improve lamb meat quality based on optimising (a) TF feed supplements (b) grazing regimes and/or (c) the use of stress tolerant breeds

[2] INRA UMR 1225.Interactions Hôte Agents Pathogènes– 23 Chemin des Capelles, 31076 Toulouse Cedex, France

[3] Université de Toulouse, ENVT, UMR 1225, 31076 Toulouse, France

[4] NAGREF-VRI NAGREF Campus, Thermi 5700, PO Box 60272 Thessaloniki, Greece

[5] NAGREF-Subtropical Plant and Olive Tree Institute of Chania, Argokepion 73100, Chania, Creta, Greece

[6] FiBL, Ackerstrasse, Postfach, CH 5070, Frick, Switzerland

[7] FiBL, Ackerstrasse, Postfach, CH 5070, Frick, Switzerland

[8] FiBL, Ackerstrasse, Postfach, CH 5070, Frick, Switzerland

[9] INRA, UR1213 - Unité de Recherches sur les Herbivores, 63122 Theix, France

[10] INRA, UE1153 - Unité Expérimentale des Monts d'Auvergne., 3210 Orcival, France

[11] Universita Degli Studi di Catania, DACPA, via Valdisavoia 5, 95123 Catania, Italy

[12] Universita Degli Studi di Catania, DACPA, via Valdisavoia 5, 95123 Catania, Italy

[13] Agriculture and Life Sciences Division, Lincoln University, Christchurch, New Zealand

[14] School of Agriculture Food and Rural Development, University of Newcastle, Nafferton Farm, Stocksfield, Northumberland, NE43 7XD, UK

[15] School of Agriculture Food and Rural Development, University of Newcastle, Nafferton Farm, Stocksfield, Northumberland, NE43 7XD, UK

Nutrition: Animal feeding studies within the LowInputBreeds project focus on the possible exploitation/incorporation of tannin rich (TR) resources in sheep feed which have been shown to:

i) modulate the biology and dynamics of GINs infection and

ii) influence the quality of products.

The different tannin rich resources to be examined are either forages [sainfoin (*Onobrychis viciifoliae*) (Switzerland, France), sulla (*Hedysarium coronarium*) (Greece)], concentrates (faba beans (Sw)) or by-products (carob by products (Greece, Italy), citrus pulp (Italy). Initially the potential anthelmintic (AH) activity of these tannin rich feeds was assessed *in vitro,* and their tannin and polyphenol concentration was analysed in Greece, Switzerland and France. Results confirmed sainfoin, carob and Faba bean extracts showed some AH *in vitro*.

In a second step (work package 2.2.2), the AH effects of these feeds, either alone or in combination, has been examined *in vivo* in sheep experimentally infected with GINS of both the abomasum (*Haemonchus contortus*) and small intestine (*Trichostrongylus colubriformis*) (Greece and Switzerland) or in France with naturally infected lambs. In Greece, nematode egg excretion was significantly reduced when sheep consumed 100 % carob concentrate. In Switzerland, sainfoin was effective to reduce egg excretion, but no additional effect was found with the addition of faba bean. The 3 year INRA study on the effect of sainfoin feeding at weaning is still in progress. Meanwhile, it was also scheduled to analyse the effect of tannin rich feeds on the quality of lamb carcass and meat and/or milk, although this is on-going.

Pictures: Animal feeding focussing on the possible exploitation/incorporation of tannin rich resources. All photographs: Thomas Alföldi, FiBL

Sainfoin field

Feeding trial with 2 sheep breeds at FiBL in Switzerland

Red Engadine sheep eating the test diet

The role of grazing management has been examined in both dairy and meat sheep production. At INRA Theix (work package 2.3.1, Task 1), the role of the herbage height (= stocking rate) for Limousine lambs in organic (organic farming, no fertiliser) vs conventional (with fertiliser on pasture) systems on the quality of carcasses has been measured in a 2-year study. Low herbage allowance was associated with a more anthelmintic treatments and a greater redness of the meat. Organic production was associated with lower evaluation by panellist but with beneficial changes (increase) in the PUFA/SFA ratio in meat. In Italy (University of Catania), the influence of time of grazing was examined between lambs maintained indoors (group S), or allowed to graze exclusively in the morning (MG), in the afternoon (AG) or for the whole day (CG). Constant grazing was logically associated with higher intake of herbage and better growth. On the other hand, this was also associated with significantly higher indole in perirenal fat (compared to the S and CG groups) and skatole content (compared to the S group).

Last but not least, **some large integrative studies** (work packages 2.2.2, 2.2.3 and 2.3.1) have been scheduled to examine interactions between different factors: genotypes, tannin rich feeds, and grazing management in Mediterranean and mountainous conditions on both GIN infections and the quality of milk and/or meat. Since these studies are planned towards the end of the project, most results and analyses are still pending. However, preliminary results show the consumption of sainfoin by lambs at weaning in France did not appear to affect muscle colour and lipid oxidation intensity. On the other hand, a collaborative study between FiBL and the University of Catania found consumption of sainfoin before slaughter increased the n-6/n-3 ratio and concentration of conjugated linoleic fatty acid (CLA) in meat, which is believed to exert positive effects on human health.

In conclusion, at mid-term of the LowInputBreeds project, results obtained within SP2 are still "patchy" for most objectives, due to some uncontrolled causes (Inappropriate weather conditions to grow TR, Earthquakes (Partner 19 in New Zealand) or re arranging an over ambitious experimental design which have created delays. Nevertheless, changes have been adopted to reorganise and adjust the experimental schedule to provide answers to the 2 main objectives (Effects of the identified factors on stress response and consequences on product quality) at the end of the project, with associated deliverables.

Subproject 3: Pig production systems[1]

Jascha Leenhouwers[2]

Overview of Subproject 3

The overall goal of subproject 3 is to improve performance, animal health and welfare, and product quality in organic and low input pig production systems. Subproject 3 is divided in three work packages (WP). The first WP focuses on breeding structures and suitable breeds for organic and low input pig production systems. Solutions will be developed appropriate for the relatively small size of this sector and its regulatory/standard requirements. Additionally, selection programmes are designed to improve priority traits required by low input pig production systems, such as pig survival, sow longevity, and heat stress resistance.

- The main objectives of the first work package are to (i) Identify the most suitable breeds currently used in low input production in different macro-climatic regions; (ii) Develop and implement breeding systems for organic and low input production systems; (iii) Identify parameters associated with heat stress resistance in warmer/tropical (e.g. Mediterranean) climates.
- The second work package focuses on developing management components to improve piglet survival in organic and low input pig productions covering gilt rearing and systems for piglet environment. The main objectives of the second work package are to determine the effects of (i) contrasting gilt rearing systems on the health and welfare and productivity of pigs; (ii) and interactions between, (a) sow genotype and (b) piglet environment during weaning/lactation on piglet health, welfare, mortality and performance.
- The third work package focuses on improving carcass, meat and fat quality in heavy pigs used for premium, regional pork products via integration of (a) genotype/breed choice and (b) feeding regimes. Specifically, this work package examines effects of breed and feeding regime on economic performance and carcass/meat quality of pigs in low input production systems.

Summary of results obtained so far

An extensive review was prepared, compiling reproductive and finishing performance of traditional and conventional breeds in low input and organic pig production in Europe, based on literature studies and farm surveys. Results showed that in comparison with traditional breeds, conventional breeds wean more piglets, have efficient and faster growth and leaner carcasses. They thrive well in the temperate summers and mild winters of North West European. The lean meat of conventional breeds is suitable for the commodity organic pork market. Traditional breeds can not necessarily be considered as a single group. On one hand they cover prolific breeds with good finishing performance (e.g. Saddlebacks, Pulawska) but also breeds kept for special meat production (e.g. Ibérico, Cinta Senese). The prolific and leaner traditional breeds may be suitable for commodity organic pork production, especially when crossed with conventional white boar breeds to give extra leanness to the carcass. Special meat breeds are unsuitable for commodity organic pork production due to their low fertility and high carcass fatness, but extra added value is obtained by their specific meat and fat quality. Based on reproductive and finishing performance, modern breeds are most suitable for commodity organic pork production. Traditional breeds are suitable for niche markets, where products have clear added value.

An economic modelling analysis of technical results from various modern breeds on Dutch organic farms showed that a rotation breeding systems provide a suitable breeding infrastructure for Dutch organic pig farmers. Two-breed rotation systems using Yorkshire and Landrace stock currently offers the best combination of profitability and usability in these systems, using boars ranked according to an organic index giving priority to traits important for organic production, e.g. piglet survival, mothering ability, sow longevity, and piglet growth.

[1] The work packages of subproject 3, pig production systems:

Work package 3.1 Development of a flower breeding system to improve pig survival and robustness related traits in small populations; comparing the performance of breeds from 'flower' and conventional breeding systems.

Work package 3.2 Effect of management innovations (gilt rearing and lactation systems) on mothering ability of sows as well as pre- and post-weaning diarrhoea and losses of piglets.

Work package 3.3 Effect of traditional, improved and standard hybrid pig genotypes and feeding regimes on carcass, meat and fat quality in heavy pigs used for premium, regional pork products.

[2] Dr. Jascha Leenhouwers, Institute for Pig Genetics IPG, 6641SZ Beuningen, The Netherlands, Tel. +31 24 6779999, jascha.leenhouwers@ipg.nl, www.ipg.nl

A genetic fingerprinting approach was designed to reduce mortality in finisher pigs. This involves genotyping dead pigs and tracing their respective fathers by means of a specifically designed Single Nucleotide Polymorphism (SNP) chip. SNP's are mutations in the genome, in which a single base in the DNA differs from the usual base at that position. Subsequently, dedicated software enables matching the correct father with the dead pig. In this way, boars (i.e. fathers) with large genetic effects on pig mortality (i.e. poor track records) can be excluded from breeding, thereby reducing pig losses.

Results of the study on genetics of heat stress show that genetic variation does exist and potentially can be used to breed sows better able to withstand heat stress, avoiding depressed fertility traits. This provides an opportunity to select appropriate lines for specific environmental conditions e.g. one for temperate areas and another for hotter, more tropical climates. Based on the knowledge so far, pig breeding programmes applied in hot, low input production environments need to consider sensitivity of sows to heat in their selection decisions.

Results on the effects of pig genotypes on performance and carcass quality show that genotypes (Angeln Saddleback *vs.* Piétrain*Angeln Saddleback *vs.* Modern hybrid genotype) differ in growth performance and carcass quality. Angeln Saddleback had the lowest growth rates and highest carcass fat yield compared to the Modern hybrid genotype, whereas the Piétrain*Angeln Saddleback cross achieved intermediate results.

Plans for the remaining 2 years

A stakeholder workshop will be organised in August 2013 to share results of subproject 3 with producers, processors and pork supply chain stakeholders. Nucleus farms will be set up for breeding a robust sow line selected to withstand all sorts of common challenges in low input production environments, e.g. heat stress, disease and mortality. Gilts with average *vs.* high genetic merit for pig survival have been reared under conventional *vs.* organic conditions. Their offspring are being monitored under three housing systems: organic farrowing pens without outdoor run, organic farrowing pens with concrete outdoor run and organic farrowing pens with concrete outdoor run and additional pasture for the piglets. Currently, the effects on maternal behaviour, piglet mortality and piglet health post weaning are being measured. A survey of fat quality parameters (fatty acid composition and skatole) in meat samples from carcasses of pigs of various genotypes (modern and traditional) produced in low input and organic systems in 3 European countries (UK, Germany, Spain) will be carried out.

Pictures: Low input farm in Brazil. This farm is used to collect data for work package 3.1 - information to develop the genetic fingerprinting approach. The data were collected by the Brazilian LowInputBreeds partner UFV (Federal University of Viçosa, Animal Science Department). All photographs: Jascha Leenhouwers, IPG

Subproject 4: Laying hens production systems[1]

Veronika Maurer[2]

In subproject 4, organic and free range conventional egg production systems are examined with regard to genotypes present and management practices and eventual interactions between genotype and management. Farmers in Switzerland, The Netherlands and France are involved in a performance recording network to identify and test genotypes and management procedures best suited for organic and free range farming.

A first survey among nearly 300 free range and organic layer farms in Switzerland, France and The Netherlands revealed that about 20 different brands of laying hen are used. Most are brown egg laying varieties with white egg varieties a minority despite initial results showing they performed relatively well. Variability in egg production and mortality between farms is large. A paper describing the findings has been accepted and will soon appear in British Poultry Science and popular have been published in poultry magazines in the 3 participating countries. Results were discussed with researchers and poultry breeding industry at the 7th European poultry genetics symposium.

In the 3 countries farmers' workshops took place to identify the ideal hen for free range systems. In Switzerland and The Netherlands there was an emphasis on robustness, translated in a moderate peak but persistent production and good eating capacity in addition to general good performance and behaviour. In France, where the survey identified lower mortality, there was greater emphasis on high egg production. Organic farmers, particularly in Switzerland and The Netherlands, indicate they want a genotype (and management system) which allows males to be raised for meat, instead of being killed at hatching. A publication is being prepared to report workshop findings.

Based on the ideas from farmers, the participating breeding company ISA selected an alternative genotype for testing. This is a brown egg laying hen, with black feathering, known for its robustness in several African countries. This genotype has been reared on one farm and tested as laying hen on two larger and 8 small organic laying farms in the Netherlands. During rearing, hen behaviour and performance was judged as good. During the onset of lay, however, most farms experienced feather pecking to such an extent, that they decided against raising the next flock for testing in free range conditions. The test flocks will be followed to the end their lay period to complete the picture.

Meanwhile another genotype (not from ISA, but a competing breeding company) became available, and one large and one small farm are interested to test this genotype. The rearing period is almost finished and hens have behaved and performed well. Of both alternative genotypes a small number of males are being reared alongside the females to 12 weeks of age and will be subsequently fattened for slaughter at 14-16 weeks of age to get an impression of suitability for meat production.

The search for new interesting genotypes/selection methods will continue.

In both Switzerland and The Netherlands 40 farms are being visited (50/50 organic/conventional) to get a better impression of management practices, production and conditions of the hens and this is about to be repeated in France. Variation in genotypes is high. All farms are judged according to a standard protocol to identify best practices, assessing feather quality, wounds and abnormalities on the breast (keel) bone and feet and data recorded include feeding, roughage provision, medical treatment, range management. During the visits farmers' attitude to experimentation with different genotypes and/or management practices (participation in the farmers network) are discussed. If promising new genotypes and/or management procedures are identified, volunteers will be identified and testing of new genotypes will take place.

[1] The work packages of subproject 4, laying hen production systems:

Work package 4.1 Development of 'farmer participatory' breeding systems to improve productivity, health and welfare and egg quality related traits; comparing standard with farmer participatory breeding systems

Work package 4.2 Effect of, and interactions between, laying hen genotypes, feeding regimes, 'welfare-friendly' moulting protocols and prolonged use of layers on performance, and animal health and welfare

Work package 4.3 Effect of, and interaction between, laying hen genotypes and management innovations on egg quality

[2] Dr. Veronika Maurer, FiBL, Ackerstrasse, Postfach, CH 5070, Frick, Switzerland

In general layer flocks are slaughtered at 70-75 weeks of age. However, dependent on the condition of the flock and egg prices some farmers keep hens for an extended laying period possibly following a moult, although it is not easy to identify factors that underpin this decision. Extended laying periods are important for sustainability reasons and flocks are being monitored during extended periods, assessing production, health and feather condition. In Switzerland hens in such flocks are tested for infection with and immunity against intestinal parasites (A. galli).

In The Netherlands work is starting to identify new (alternative) protein sources especially for organic poultry diets considering their effect on productivity and, more important, feather quality of hens. In the original plans it was aimed to perform tests with meat and bone meal as a dietary factor that might reduce feather pecking, but an EU decisions on re-introducing meat and bone meal has been delayed hence the need to find an alternative experimental protein.

Physical egg quality characteristics (including egg weight, second graded egg and haugh units) are being measured in a subsets of farms with differing pasture management, that might cause variation in intake of 'greens', fatty acid composition of yolks will be analysed in early summer eggs (expected highest intake of green material) and winter eggs (expected lowest intake of green material).

Pictures: Pictures from the Dutch network.
All photographs: Monique Bestman, Louis Bolk Institute

Silver hens on a Dutch organic farm

Silver hens on a Dutch organic farm

Laying hens on a Dutch organic farm

White hens on a Dutch free range farm

Pictures: In each flock, 50 animals are scored for feather damage, wounds, and breastbone deformations. All photographs: Thomas Alföldi, FiBL

Scoring the breastbone

Scoring wing feathers

Scoring feet

Work package 5: Economic and multi-criteria impact assessment

Helen Bing[1]

Work package 5.1 focuses on the development of a standard protocol for multi-criteria evaluation of the social, economic, environmental impacts of four types of livestock production systems, including dairy cows, sheep, pigs and laying hens, across different European countries. The defined protocol is expected to serve as a comprehensive evaluation tool offering a number of functions. It will not only allow us to evaluate the performance of different livestock systems in terms of the respective social, economic and environmental sustainability, but also to estimate the effects of government intervention regimes related to the recent reforms in the EU agro-environmental policies, as well as the impacts of breeding and agronomic/husbandry innovations resulted from the LowInputBreeds project.

Research activities in WP5.1 are organized in three phases. Phase 1 has been conducted and concluded in 2010, and it refers to the identification of above mentioned livestock production systems falling within the scope of breeding innovations. We have now just entered Phase 2, which aims to identify and develop a standardized multi-criteria assessment protocol, based on a literature review of similar existing models for different livestock systems, along with experts' justifications from partners in the LowInputBreeds project. Finally, Phase 3 will focus on testing and implementing the developed protocol in selected regional cases across Europe. The results from work package 5.1 will contribute to decision-making relating to sustaining local livestock production systems and coping with climate change stress on different animal breeds in the European Union.

[1] Université catholique de Louvain, 2 Place Montesquieu Ottignies LLN 1348, Belgium

Abstracts of the papers presented at the Second LowInputBreeds Symposium in Hammamet, Tunisia, in May 2012

About the second LowInputBreeds Symposium

The second symposium of the LowInputBreeds project took place on May 15 to 18, 2012 in Hammamet, Tunisia. It was held in together with the 14th International Seminar of the FAO-CIHEAM[1] Network Sub-Network on Sheep and Goat Nutrition, Sub-Network on Nutrition[2]. The seminar was entitled "**Feeding and management strategies to improve livestock productivity, welfare and product quality under climate change**". This seminar was organised by the National Institute of Agricultural Research of Tunisia (INRAT) and the Pasture and Livestock Agency (OEP-Tunisia) & Mediterranean Agronomic Institute of Zaragoza (CIHEAM-IAMZ).

The event was hosted by the National Institute of Agricultural Research of Tunisia (INRAT), and it constituted an opportunity for participants to showcase their basic research, findings and practices in the various thematic sessions.

On the following pages, the abstracts of the papers from the LowInputBreeds project presented at the seminar can be found. The full book of abstracts is available at the LowInputBreeds project website http://www.lowinputbreeds.org/symposium-2012.html.

Full version of accepted papers will be published in a proceedings, the Options Méditerranées, published by the Institute of Mediterranean Agriculture Saragosse, Spain (CIHEAM-IAM Zaragoza).

Closing session of the 14th seminar of the FAO-CIHEAM Network on Sheep and Goats and second Symposium of the LowInputBreeds project. From left to right: E. Molina-Alcaide. EEZ-CSIC, Granada, Spain; L. Biondi, Univ. of Catania, Italy; H. Ben Salem, INRAT, Tunisia; Gillian Butler, Newcastle University, UK; A. Priolo, Univ. Catania, Italy; M. Rekik, ENMV, Tunisia

[1] FAO = Food and Agriculture Organisation of the United Nations, www.fao.org

CIHEAM: International Centre for Advanced Mediterranean Agronomic Studies, www. ciheam.org

[2] Information on this subnetwork is available at http://www.iamz.ciheam.org/en/pages/paginas/pag_investigacion3a.htm

Session animal welfare / product quality

The role of biotic and abiotic stress factors on sheep welfare: The example of parasites and climatic changes

S. Sotiraki[1], A. Stefanakis[2], H. Hoste[3], V. Maurer[4], G. Butler[5], C. Leifert[6]

Keywords: Stress, sheep, gastrointestinal nematodes, climatic change.

Traditional Mediterranean small ruminant production systems mostly involve local breeds, which are bred under outdoor systems using natural ligneous vegetation and cereal stubble as major dietary components. Biotic stress factors as for example infections with gastrointestinal nematodes remain one of the main threats for the health and the welfare in 'low input' conditions. Gastrointestinal parasites can cause unthriftiness, reduced production, increased susceptibility to disease and other pests, and even death. Abiotic stress factors (e.g. temperature stress and imbalanced diets) are known to result in significant reductions in yield and product quality. Predicted changes in climate are expected to increase heat stress incidence, especially in Southern Europe. Abiotic stress is also known to increase the susceptibility of sheep to gastrointestinal parasites. The impact of climate change includes increased water and heat stress, damaged ecosystems, and rising sea levels. The actual effects are heterogeneous and region specific. Yet, in most cases, the harmful effects outweigh the benefits and disproportionately hurt the poorest, which have the least capacity for adaptation. Climatic change will reduce grain yields, will impair pasture quality and quantity, will direct affect pathogens distribution and cause discomfort to the animals influencing their health and productivity status. Adaptation of livestock in such changing environment should be a key element in all choices and development strategies. Such strategies should support sustainable and modern animal production management which will include adaptation of appropriate breeding systems, selection of robust indigenous breeds, rational waste management, and balanced diets.

[1]NAGREF-VRI, NAGREF Campus, PO Box 60272, Thermi 57001 Thessaloniki, Greece

[2]NAGREF-VRI, NAGREF Campus, PO Box 60272, Thermi 57001 Thessaloniki, Greece

[3] UMR 1225 INRA/DGER, Ecole Nationale Vétérinaire de Toulouse, 23 Chemin des Capelles, 31076 Toulouse Cedex, France

[4] Research Institute of Organic Agriculture (FiBL), Postfach/Ackerstrasse, CH-5070 Frick, Switzerland

[5] Nafferton Ecological Farming Group, Newcastle University, Nafferton Farm, Stocksfield, Northumberland NE43 7XD, UK

[6] Nafferton Ecological Farming Group, Newcastle University, Nafferton Farm, Stocksfield, Northumberland NE43 7XD, UK

Plant secondary compounds in small ruminant feeding: Effect on meat oxidative stability

G. Luciano[1] and A. Priolo[2]

Keywords: Meat oxidative stability, small ruminants, phenolic compounds, essential oils.

Restrictions on the recourse to synthetic compounds in animal feeding justifies the on-going research on the alternative use of plants containing bioactive molecules, which might contribute to the implementation of sustainable and low-input production systems. Moreover, several plants so far neglected in tropical and sub-tropical environments as well as many agri-industrial by-products, are rich sources of bioactive compounds, and their appropriate use in small ruminant feeding could be promoted. Phenolic compounds (PhCs) and essential oils (EOs) are likely to be the plant secondary compounds currently receiving the greatest attention. Diets enriched in phenolic compounds can have a strong positive impact on meat quality. The stability of meat to the oxidative processes responsible for off-flavours development and discolouration over storage or display is a main concern in the meat production chain. The dietary administration of antioxidants can effectively improve meat oxidative stability. A number of PhCs and EOs possess antioxidant properties and are used as additives in meat packaging for extending meat shelf life. However, the role of dietary PhCs and EOs in contrasting meat oxidative deterioration is still under debate and contrasting results have been provided so far. In some instances, dietary PhCs were shown to extent meat colour stability with no corresponding effect on lipid oxidation. Other studies reported pronounced protective effects of PhCs against muscle lipid peroxidation but did not investigate colour stability. In the case of EOs, their strong antimicrobial properties might partially account for their positive effects on meat shelf life. Moreover, further research is certainly needed to clarify the bioavailability of these molecules in the animal organism and, consequently, their in vivo antioxidant properties. In the case of PhCs, studies have shown that simple monomeric molecules can be absorbed in the gastrointestinal tract and delivered to different tissues. However, the active degradation and absorption of more complex compounds, such as condensed tannins, are not yet confirmed. Consequently, the in vitro estimation of the antioxidant capacity of PhCs may not reflect their efficacy in vivo and the variability in the proportion of the different classes of PhCs between different natural sources should be taken into account.

[1] Department DISPA, Division of Animal Production Science, University of Catania, Via Valdisavoia 5, 95123, Catania, Italy

[2] Department DISPA, Division of Animal Production Science, University of Catania, Via Valdisavoia 5, 95123, Catania, Italy

Is sheep milk quality and quantity affected by gastrointestinal nematodes parasitism and subclinical mastitis?

N. Voutzourakis[1,2], N. Tzanidakis[3], A. Stefanakis[4], G. Butler[5], S. Sotiraki[6]

Keywords: Milk yield, quality, gastrointestinal nematodes, subclinical mastitis, Somatic Cell Count

Dairy sheep farming is an important economic activity for the countries of the Mediterranean basin. Biotic stress factors that affect health status of the ewe, such as parasitism (especially by gastrointestinal nematodes - GIN) and/or subclinical mastitis, could have a negative effect on milk quantity and quality. Our study investigates the correlation between GIN burdens and/or the presence of subclinical mastitis on milk yield and quality parameters. The study was conducted in Crete, Greece, enrolling ewes of the Sfakion breed; the major sheep population on the island. In total, 400 ewes belonging to 10 extensive and 10 semi-intensive sheep flocks (20 animals from each farm equally allocated to both lambing periods) were monitored for two consecutive lactations. From all animals, individual milk and faecal samples were collected monthly. Faecal samples were processed with modified McMaster technique and milk samples chemical composition, Colony Forming Units (CFU) and Somatic Cell Count (SCC) were assessed by infrared methods. Results to date showed that milk fat and protein content ($P<0.001$) was negatively correlated with the number of GIN egg per gram. Differences were identified between different management system and lambing periods. For SCC a positive correlation was identified with protein content and a negative with lactose content ($P<0.001$), regardless lambing period or management system. Correlation with fat content was weak and differed between lambing periods ($P<0.001$). Average daily milk yield of semi-intensive system ewes was 0.8 litres and positively correlated with SCC, while for the extensive system ewes it was 0.6 litres and negatively correlated with SCC ($P<0.001$).

[1] Nafferton Ecological Farming Group, Newcastle University, UK
[2] Veterinary Research Institute, NAGREF, Greece
[3] Veterinary Research Institute, NAGREF, Greece
[4] Veterinary Research Institute, NAGREF, Greece
[5] Nafferton Ecological Farming Group, Newcastle University, UK
[6] Veterinary Research Institute, NAGREF, Greece

In vivo and *in vitro* efficacy of sainfoin against *Eimeria* spp in lambs

A. Saratsis[1,2], I. Regos[3], N. Tzanidakis[4], N. Voutzourakis[5], A. Stefanakis[6], D. Treuter[7], A. Joachim[8], S. Sotiraki[1 9]

Keywords: *Onobrychis viciifolia*, sainfoin, *Eimeria*, polyphenols, tannins, sheep

As an alternative to chemical treatment, the *in vivo* and *in vitro* effect of sainfoin (*Onobrychis viciifolia*) hay against ovine coccidia was evaluated in the present study. Weaned lambs were allocated into two treatment groups receiving diet based on either lucerne (*Medicago sativa*) or sainfoin. The trial was performed in triplicate enrolling 24, 16 and 16 lambs respectively, all naturally infected and additionally challenged with *Eimeria crandallis* oocysts in the last two trials. Faecal oocysts excretion, faecal consistency and weight gain were recorded weekly for 7 (trial 1) or 8 (trial 2 and 3) weeks. Moreover, the *in vitro* effect of 39 phenols-containing plant extracts coming from 32 different sainfoin varieties (quantified by HPLC for their phenolic composition) was also tested in an oocyst sporulation inhibition assay. A reduction in the mean oocyst excretion rates was observed in trial 1 and 3 starting three to four weeks after sainfoin hay administration. This reduction, ranged between 21.3% (trial 1) and 61.7 % (trial 3) compared to the control values. As a result, a decrease in the total number of oocysts excreted was observed from week 3 or 4 to the end of those two trials respectively (trial 1: 48.2% reduction, p=0.05; trial 3: 49.7% reduction, p=0.06). The observed oocyst reduction may suggest a reduced infection risk, through a reduced contamination of the farm environment. However, a significant inhibitory effect on *Eimeria* oocyst sporulation was not recorded during the *in vitro* trial. Further studies are needed to better understand sainfoin mode of action against *Eimeria.*

[1] Veterinary Research Institute, National Agricultural Research Foundation, NAGREF Campus, PO Box 60272, 57001 Thermi, Greece

[2] Institute of Parasitology, Department of Pathobiology, University of Veterinary Medicine Vienna, Veterinaerplatz 1, A-1210 Wien, Austria

[3] Technische Universität München, Fachgebiet Obstbau, Dürnast 2, 85354 Freising, Germany

[4] Veterinary Research Institute, National Agricultural Research Foundation, NAGREF Campus, PO Box 60272, 57001 Thermi, Greece

[5] Veterinary Research Institute, National Agricultural Research Foundation, NAGREF Campus, PO Box 60272, 57001 Thermi, Greece

[6] Veterinary Research Institute, National Agricultural Research Foundation, NAGREF Campus, PO Box 60272, 57001 Thermi, Greece

[7]Technische Universität München, Fachgebiet Obstbau, Dürnast 2, 85354 Freising, Germany

[8]Institute of Parasitology, Department of Pathobiology, University of Veterinary Medicine Vienna, Veterinaerplatz 1, 1210 Wien, Austria

[9] [1]Veterinary Research Institute, National Agricultural Research Foundation, NAGREF Campus, PO Box 60272, 57001 Thermi, Greece

Subclinical mastitis and gastrointestinal nematode parasitism in dairy sheep flocks of Greece. Their intensity in low input management systems and interactions between them

N. Tzanidakis[1,2], N. Voutzourakis[3], A. Stefanakis[4], C. Brozos[5], E. Kiossis[6], S. Sotiraki[7]

Keywords: Subclinical mastitis, gastrointestinal nematodes, sheep, management system

Aim of this study was to investigate the effect of the most common biotic stress factors (i.e. subclinical mastitis and gastrointestinal nematodes (GIN) infection), on dairy sheep reared under "low-input" management systems and also to detect potential interactions between those two pathological conditions. This study included 10 extensive (diet based on free grazing of low quality mountain pastures throughout the year, concentrated feed provided during wintertime) and 10 semi-intensive (diet based on grazing in high quality private pastures, concentrated feed provided constantly) sheep flocks in Crete, Greece. From each flock faecal and milk samples were taken on monthly basis from 20 'Sfakiano'-breed ewes, for 9 consecutive visits. Faecal samples were processed with modified McMaster technique, in order to assess GIN eggs per gram(epg) numbers while milk samples were analysed for Somatic Cell Count(SCC) and processed with microbiological examinations(when SCC>500,000). Low GIN epg counts encountered in both systems (31.3 ±3.6 and 43.6 ±2.3 in semi-intensive and extensive system, respectively). Ewes of semi-intensive system showed a peak of GIN epg during June/July. Management system had a significant effect on GIN epg ($p<.05$ and $p<.001$, respectively) and SCC ($p<.05$ and $p<.001$, respectively). In average, one out of ten udder teats examined microbiologically, had subclinical mastitis. Positive milk microbiological samples prevailed more in the semi-intensive system. The management system, the lambing period and their interaction did not show any effect on subclinical mastitis. During this first gross analysis no correlation between GIN infection and subclinical mastitis was detected, but this needs to be further investigated.

[1] NAGREF-Veterinary Research Institute (VRI), Thessaloniki, Greece
[2] Clinic of Farm Animals, Veterinary Medicine Faculty, AUTH, Thessaloniki, Greece
[3] NAGREF-Veterinary Research Institute (VRI), Thessaloniki, Greece
[4] NAGREF-Veterinary Research Institute (VRI), Thessaloniki, Greece
[5] Clinic of Farm Animals, Veterinary Medicine Faculty, AUTH, Thessaloniki, Greece
[6] Clinic of Farm Animals, Veterinary Medicine Faculty, AUTH, Thessaloniki, Greece
[7] NAGREF-Veterinary Research Institute (VRI), Thessaloniki, Greece

Effect of different condensed tannin sources on gastrointestinal nematodes in periparturient ewes

S. Werne[1], E. Perler, V. Maurer, Z. Amsler, J. Probst, C. Zaugg, I. Krenmayr, F. Heckendorn

Keywords: Gastrointestinal nematode, periparturience, sheep, condensed tannin, sainfoin, faba bean

Previous research has pointed out the potential of condensed tannin (CT) containing feed sources to reduce faecal egg count (FEC) of sheep infected with gastrointestinal nematodes (GIN). The present study verified the possibility of sainfoin (*Onobrychis viciifolia,* cv. Visnovsky) and field bean (*Viciafaba,*cv. Scirocco) as single CT sources as well as in combination for additional synergic effects, to reduce periparturient egg rise of ewes in late gestation and early lactation. A herd of Red Engadine Sheep in gestation and naturally infected with gastrointestinal nematodes was superinfected with 1500 infective third stage larvae of *Haemonchus contortus* 24 days prior to start of the trial. Ewes were allocated to 4 groups and fed either (*i*) sainfoin (n = 19), (*ii*) a ryegrass-clover mixture (n = 21), (*iii*) faba bean pellets and ryegrass-clover forage (n = 19) and (*iv*) a combined CT-feed consisting of sainfoin and faba bean pellets (n = 19). Diets were supplemented with commercial non-CT concentrates in order to balance protein and energy intake between groups. During the 24 day trial period faecal sampling took place every 3rd to 4th day. FEC were expressed per gram faecal dry matter (FECDM). Mean lambing date was on trial day 10.63 ± 1.68 and no significant differences were found between groups for this factor. FECDM in the sainfoin group was significantly reduced from day 7 to the end of the trial when compared to the control group. No significant differences were found between the control and the faba bean group.

[1] All: Research Institute of Organic Agriculture (FiBL), Ackerstrasse, Postfach, CH 5070, Frick, Switzerland

Feeding sainfoin to goats – Influence on milk and cheese quality and yield

F. Heckendorn[2], M. Schwery[3], H. Volken[4], V. Maurer[5], X. Simonnet[6]

Keywords: Sainfoin, goat, milk, cheese, quality

Although the administration of sainfoin is associated with anthelmintic effects, information on the consequences of feeding this legume on product quality is scarce. In the present study we looked at milk quality and yield of goats fed either sainfoin or non-tanniferous control forage. Twelve lactating goats of the alpine breed were used for the study. They received grass/clover hay for a period of 15 days (grass clover feeding period, GCFP). Then the feed was switched to sainfoin hay (approx. 90 % of daily intake) for another 15 days (sainfoin feeding period, SFP). Both feeds were supplemented with concentrates in order to guarantee isoproteic and isoenergetic feeding throughout the trial. Milk yield and quality (fat, protein, energy and urea) were determined for every goat at day 10 of the respective feeding periods. Furthermore, the milk of the animals from day 4 to 15 of the respective feeding periods (i.e. hay/grass, sainfoin) was transformed to cheese. There was no difference in milk yield between GCFP and SFP (1.54 and 1.37 kg for GCFP and SFP respectively, p=0.17). Sainfoin feeding was associated with a significantly higher (P<0.001) milk protein concentration when compared to grass/clover feeding. Also, compared to GCFP, milk fat content was significantly lower in SFP (p<0.05). Cheese yield was numerically higher for SP when compared to GCP. A sensory panel evaluated the taste of the cheese produced from 'sainfoin milk' to be significantly different from cheese produced from 'grass/clover milk' (p<0.05). However, both types of cheese were judged to be equally tasty. We conclude that sainfoin feeding to goats has no negative influence on milk yield and has a positive effect on milk protein content.

[2] Department of Animal Husbandry, Research Institute of Organic Agriculture, Ackerstrasse, 5070 Frick, Switzerland
[3] Swiss Competence Center for Small Ruminants, Landw. Zentrum Visp, Talstrasse 3, 3930 Visp, Switzerland
[4] Swiss Competence Center for Small Ruminants, Landw. Zentrum Visp, Talstrasse 3, 3930 Visp, Switzerland
[5] Department of Husbandry, Research Institute of Organic Agriculture, Ackerstrasse, 5070 Frick, Switzerland
[6] Médiplant, Research Centre on Medicinal Plants, Route des Vergers 18, 1964 Conthey, Switzerland

Comparison of meat and carcass sensory quality in organically and conventionally pasture-fed lambs at two levels of herbage allowance

S. Prache[1], J. Ballet[2], K. Meteau[3], P. Gatellier[4], H. Hoste[5], F. Guy[6], M.A. Musset[7], E. Vannier[8]

This study was carried out over 2 successive years (2010 and 2011) using 96 castrated male Limousine lambs in the following experimental design: 2 levels of mineral N fertilisation on the pastures (0 vs. 100 kg N/ha; O vs. C) x 2 levels of pasture allowance (High vs. Low; H vs. L). The differential in N mineral fertilisation started from year 2000 onwards. Each year, 24 lambs from a conventional flock (C)and 24 lambs from an organic flock (O) were assigned at weaning (mean lamb age and live weight of 90 d and 24.8 kg respectively) to 1 of the 4 treatments (OH, OL, CH, CL). The herbage allowance was managed to obtain a mean lamb age at slaughter of 5 and 6 months in the high (H) and the low (L) herbage allowance. There were therefore 4 groups of lambs at pasture each year: OH, CH, OL and CL. Herbage allowance was adjusted for each group in order to achieve similar mean growth profile and age at slaughter for OH and CH lambs on one side and OL and CL lambs on the other side. All lambs were treated against internal worms at weaning, and then on an individual basis to ensure growth profile was not biased by parasitism. There was an effect of the level of herbage allowance on mean lamb growth rate and age at slaughter, but, as planned, there was no difference between O and C lambs. H and L lambs were slaughtered on average at 155 d and 203 d, respectively. As expected, there was no effect of either experimental factor on live weight at slaughter, cold carcass weight, carcass conformation and fatness, and perirenal fat weight. At 24 h display, there was no effect of experimental factors on longissimuslumborum (Ll) muscle PH, but redness of longissimuslumborum muscle after 2h blooming was higher in L lambs than in H lambs; the colour of the muscle was not different between O and C lambs. There was no effect of experimental factors on the other Ll muscle colour parameters nor on Ll muscle lipid oxidation intensity. In the first experimental year, the overall liking of chops assessed by trained panellists was lower in O lambs than in C lambs and was not different between H and L lambs. The lamb sensory evaluation is still being processed for lambs produced in year 2 experiment.

[1] UR1213, Unité de Recherches sur les Herbivores, INRA, 63122 Theix, France

[2] UE1153, Unité Expérimentale des Monts d'Auvergne, INRA, 63210 Orcival, France

[3] UE1206, Unité Expérimentale Elevage Alternatifs et Santé des Monograstriques, INRA, 17700 Saint-Pierre-d'Amilly, France

[4] UMR1225, UMR Interactions Hôtes-Agents Pathogènes, INRA, 31076 Toulouse, France

[5] UMR1225, UMR Interactions Hôtes-Agents Pathogènes, INRA, 31076 Toulouse, France

[6] UR1213, Unité de Recherches sur les Herbivores, INRA, 63122 Theix, France

[7] UR1213, Unité de Recherches sur les Herbivores, INRA, 63122 Theix, France

[8] UR1213, Unité de Recherches sur les Herbivores, INRA, 63122 Theix, France

Session on options for mitigating/ coping with climate change

Impact of climate change on dairy cattle performances and vice versa: Considering both sides of the story

S. König[1]

Changes in temperature and in relative humidity as a result of global warming can cause heat stress in dairy cattle. The aim of a first study was to assess the impact of heat stress in Holstein cows on the female fertility trait 'conception rate (CR)' and on test-day production traits in three different production systems in the state of Lower Saxony, Germany. Production systems were defined as follows: A production system characterized by intensive crop production (= indoor housing), a pasture based production system, and a maritime region at the coast. Heat stress was assessed by daily temperature-humidity indices (THI) modelled as random regression coefficients. In all production systems, THI=70 was identified as a general threshold denoting a substantial decline in test-day milk yield and protein yield. For female fertility, THI = 60 was identified as a general threshold denoting a substantial decline in CR. Best results for CR were observed for THI < 45; especially for high yielding cows which responded sensible to increasing THI. Regarding genetic parameters, heritabilities for CR were relatively constant in the course of THI, but heritabilities for protein yield slightly decreased with increasing THI. Genotype by environment interactions did not exist. As a first conclusion, global warming has detrimental effects on dairy cattle productivity, however in turn, there is also a negative contribution of dairy cattle themselves on climate, especially via methane emissions. The second part of the presentation will focus on breeding strategies for reduced methane emissions based on a review of literature.

[1] Department of Animal Breeding, University of Kassel, Germany

Local feed resources for poultry

F. Leenstra[2]

In poultry 'no input', 'low input' and commercial production can be distinguished. 'No input' implies scavenging poultry with some kitchen waste or crop residues as supplemental feed. Input is negligible and economic efficiency high if there is any output. Commercial production is capital intensive and completely based on supplied feed. Birds might be given outside access for foraging, but this is for behavioural and welfare reasons, not for nutrition. For this type of production rational economy based choices have to be made and sales of eggs and/or birds generate more income than diet, housing and other costs. Chickens are real omnivores. The feed industry utilizes all kinds of ingredients and by-products for least cost rations. Literature provides a tremendous amount of information on feeding value of a wide variety of feed ingredients. Low input systems are a difficult category. Birds often have to get part of their diet from scavenging, but also receive on a regular basis (compound) feed. This can be home-made from local resources or industrial and thus out-of-pocket costs. Purchase of feed is only possible if sufficient income can be generated from sales of eggs or birds. Lack of market access (buying resources and selling products) and competition from industrially produced eggs and meat are more a barrier than knowledge on feed resources. With regard to management no input and low input systems have a tendency to 'over-graze' the resources for scavengers, with high mortality and low productivity as a consequence. Reducing numbers of birds might increase productivity.

[2] Wageningen UR, Livestock Research, PO Box 65, 8200 AB Lelystad, The Netherlands, e-mail ferry.leenstra@wur.nl

Adaptation of poultry to hot climates using tropical relevant major genes

A.R. Sharifi[1], H. Simianer[2]

During the last decades, an intensive immigration of high-yielding breeds from temperate to tropical countries has taken place, and these breeds have been used in different breeding programs. The use of this genetic material requires cool environmental conditions which entail high rates of resources and energy consumption. This costly management approach is highly questionable in view of the current discussions about sustainable farming and the anticipated global warming. Native fowl can be used as reservoir for genomes and major genes with direct or indirect effects on adaptability. Particular major genes such as the frizzled plumage, naked neck, sex-linked dwarf and slow-feathering gene have been identified to have positive effects on heat tolerance. In a series of studies the effect of heat stress on the reproductive traits of hens of broiler breeder lines carrying major genes for frizzle (F, in dam lines) and naked neck (Na, in heavy sire line) is investigated. Compared to temperate condition thermal stress (30°C) in normally feathered hens causes a distinct depression in growth and reproductive traits. In comparison with the NaNa genotype the normally feathered hens of the heavy broiler line showed clear performance depressions under thermal stress with respect to egg production (63 %), fertility (20 %) and number of chicks (72 %). Also in the dam line, frizzled hens (FF) were superior in egg performance, fertility and number of chicks compared to their normally feathered counterparts. This emphasizes the need for breeding programmes for improving performance for suboptimal conditions exploiting tropical relevant major genes.

[1]Department of Animal Sciences, Animal Breeding and Genetics Group, Georg-August University Gottingen, Germany

[2] Department of Animal Sciences, Animal Breeding and Genetics Group, Georg-August University Gottingen, Germany

Genetic aspects of heat stress in pigs expressed in fertility traits

S. Bloemhof[3,4], E.F. Knol[5], E.H. van der Waaij[6], J. I. Leenhouwers[7]

Sows are exposed to heat stress when temperature exceeds 20°C, which is the upper critical temperature of a sow's thermo-neutral zone. Heat stress decreases the expression of oestrus behaviour, alters ovarian follicle development, compromises oocyte competence, and inhibits embryonic development. Management practices such as cooling offer one option to reduce heat stress and warrant performance during hot seasons. A more sustainable alternative is to breed sows for improved heat tolerance. This would reduce the need of costly management practices and is more sustainable in terms of its ecological footprint. We were confronted by the reality of detrimental heat stress effects when evaluating the performance of two of our dam lines in Spain and Portugal. These two dam lines, differed in the relationship between ambient temperature and reproductive performance. One of the dam lines showed no influence of temperature on performance, the other showed a decrease of 0.1 piglet per 1°C increase in ambient temperature. In a subsequent study, estimates of heritability reinforced the idea that genetic selection for sow heat stress tolerance may be possible. Genetic correlations between reproductive performance in a temperate climate and reproductive performance in a hot climate tend to be unfavourable. In other words, improving reproduction traits without taking heat tolerance into account will lead to animals which have higher performance under temperate conditions, but which are also more sensitive to heat stress.

[3] Institute for Pig Genetics B.V., Beuningen, The Netherlands

[4] Animal Breeding and Genomics Centre, Wageningen University, Wageningen, The Netherlands

[5] Institute for Pig Genetics B.V., Beuningen, The Netherlands

[6] Animal Breeding and Genomics Centre, Wageningen University, Wageningen, The Netherlands

[7] Institute for Pig Genetics B.V., Beuningen, The Netherlands

Events

August 26-30, 2013: 64th EAAP Annual Meeting, Nantes, France

The 64th meeting of the European Association of Animal Science will include sessions from the LowInputBreeds project (3rd LowInputBreeds symposium).

More information www.eaap.org/content/meetings.htm

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Partner 1: Newcastle University UNEW, UK, Coordinator
Partner 2: Research Institute of Organic Agriculture FiBL, Switzerland, Scientific coordinator
Partner 3: Institut National de la Recherche Agronomique INRA, France
Partner 4: Wageningen UR, Livestock Research, The Netherlands
Partner 5: University of Göttingen / Georg-August-University Göttingen UGöt, Animal Breeding and Genetics Group, Germany
Partner 6: University of Catania UCat, Department of Animal Sciences, Italy
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Partner 20: University of Guelph UG-CAN, Centre for Genetic Improvement of Livestock, Canada
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Partner 22: Louis Bolk Institute, Driebergen, The Netherlands

Publications of the LowInputBreeds project

Publications of the LowInputBreeds project can be downloaded at the project website www.lowinputbreeds.org > Publications.

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Contact for the LowInputBreeds Newsletter

- Dr. Helga Willer, Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, Tel. +41 62 8657272, Fax +41 62 865 72 73, e-mail helga.willer@fibl.org, www.fibl.org, www.lowinputbreeds.org
- Gillian Butler, Nafferton Ecological Farming Group, Newcastle University, Stocksfield, Northumberland, UK, Tel. +44 1661 830222, e-mail Gillian.Butler@ncl.ac.uk

Project contacts

- Gillian Butler, Project coordinator, Nafferton Ecological Farming Group, Newcastle University, Stocksfield, Northumberland, UK, Tel. +44 1661 830222, e-mail gillian.butler@newcastle.ac.uk
- Dr. Veronika Maurer, Scientific coordinator, Animal Husbandry, Research Institute of Organic Agriculture FiBL, Frick, Switzerland, Tel. +41 62 865 72 57, e-mail veronika.maurer@fibl.org

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