Is there room for selection for meat quality in local breeds? - a simulation study

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Q-PorkChains, an EU-project in the 6th framework

The aim is to develop high quality pork products in sustainable production systems

www.q-porkchains.org

Sustainable use of genetic resources

... the use of the components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity,

thereby maintaining its potential to meet the needs and aspirations of present and future generations

Convention on biological diversity, FAO, 2004

Why are local breeds important?

The variation between breeds represents
30 to 50% of the total genetic variation

Hammond & Leitch, 1996

European local breeds account for >50% of the total European between-breed microsatellite diversity

Ollivier et al, 2005

"Loss of local breeds will cause cultural erosion and diminish the ability of communities to maintain their cultures and livelihoods."

FAO, 2007

Global plan of action for animal genetic resources

FAO, 2007

Priorities for action:

1. Inventory, monitoring and characterization
2. Sustainable use and development
3. Conservation of animal genetic resources
4. Policies, institutions, capacity building

Gandini & Oldenbroek, 2007:

Strategies for moving from conservation to utilisation

- Defining the breeding goal
- Marketing the products to secure profitability
- Reducing genetic risks by managing diversity

Selection in a local breed

"Old" breed and small scale

→ less effective production

→ expensive products

Although consumers are willing to pay for "ethical quality" (Liljenstolpe, 2008), product quality must be "OK"

Characteristics of the simulated local breed

Small scale, but commercial production
Data base, breeding organisation and AI exist

High quality, niche products
Old and heavy pigs at slaughter
Meat (or carcass) quality is important
Quality trait recorded at slaughter house

Characteristics of the simulated local breed

35 herds with 24 sows / herd

Population size   840 sows, 18 boars

Number of animals and herds for some breeds

Breed	Sows	Boars	Herds	Sows/ herd
Simulated breed	840	18	35	24
Basque black pied	517	76	29	18
Black Mallorcan pig	1300	120	68	19

Characteristics of the simulated local breed

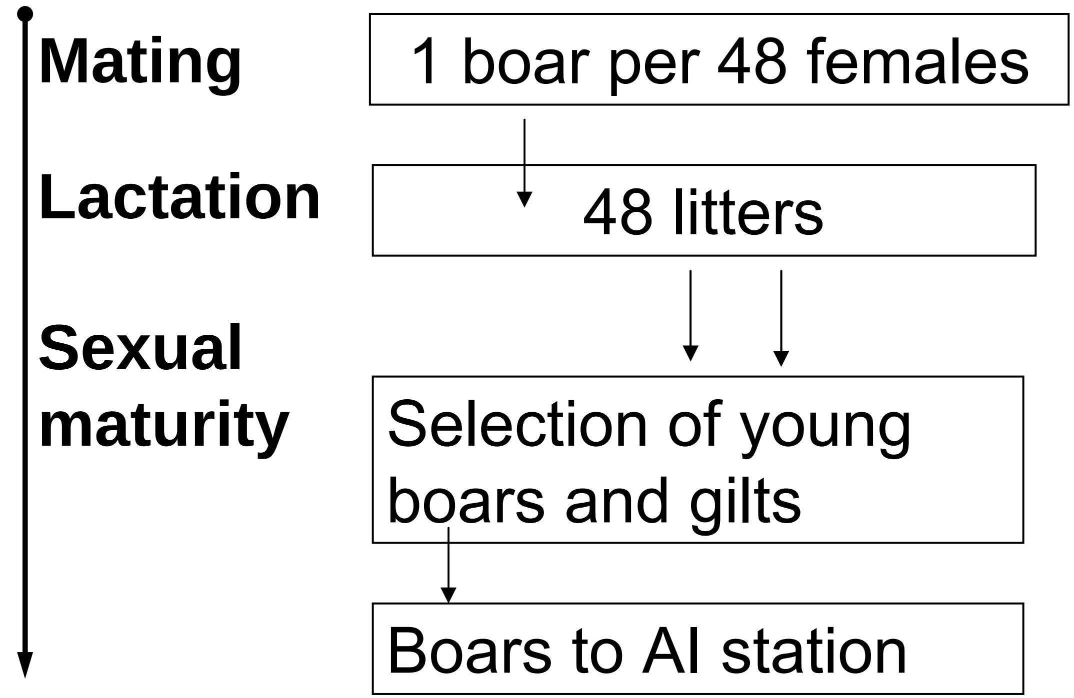
35 herds with 24 sows / herd
Population size   840 sows, 18 AI-boars

6 pigs / litter
2 litters / year
Max. 6 litters / sow

Age at slaughter is higher than age at first service → no records from full sibs yet

Random mating among selected animals

Characteristics of the simulated local breed



Only one selection trait, a quality trait

Two simulated, alternative traits

$h^2 = 0.2$ e.g. ultimate pH

$h^2 = 0.4$ e.g. intramuscular fat

$\sigma^2_G = 1$

Three alternative schemes

No selection

BLUP selection

Optimum Contribution Selection

Simulation program

ADAM	Pedersen et al, 2009
EVA	Berg et al 2006
DMU	Madsen and Jensen, 2008

Optimum Contribution Selection

Animals are selected on genetic merit and average relationship to all potential breeders in the population

Meuwissen, 1997; Grundy et al, 2000

Contribution → $C = \underbrace{x'\hat{a}}_{\text{BLUP breeding value}} + \lambda \overbrace{x'Ax}^{\text{average relationship with potential breeders}}$

BLUP breeding value

average relationship with potential breeders

weight given to relationship, relative to genetic merit

Optimum Contribution Selection

λ chosen so that rate of inbreeding is 1% per generation

$$C = x'\hat{a} + \lambda x'Ax$$

weight given to relationship, relative to genetic merit

15 years simulated
50 replicates per alternative

Results from 840 sows & 18 AI-boars

Genetic gain per year and inbreeding rate per generation

h^2	Scheme	ΔG, gen std	ΔF, %
	No sel	0.00	0.30
0.2	BLUP	0.42	4.80
0.4	BLUP	0.47	4.00
0.2	Opt contr	0.35	0.97
0.4	Opt contr	0.42	1.00

Lower heritability - lower genetic gain n.s.
- larger increase in inbreeding n.s.

No selection - no genetic gain
- inbreeding increases anyway

Optimum contribution - it works!

Comparison between population sizes

840 sows & 18 AI-boars vs 1848 sows & 39 AI-boars

Scheme	ΔG, gen std	ΔF, %	Pop size
No sel	0.00	0.30	small
No sel	0.01	0.20	larger
BLUP	0.47	4.00	small
BLUP	0.50	2.30	larger
Opt contr	0.42	1.00	small
Opt contr	0.47	0 73	larger

ΔG could be larger

Room for lower λ

Conclusion

With optimum contribution selection, considerable genetic progress can be achieved together with an acceptable inbreeding rate, also in a small population

To discuss

- Use of AI in local breeds
- Who would run the genetic evaluation?
- Special management routines limiting breeding, e.g. an old "leader sow" in each family group

To discuss

Farmers with local breeds are (sometimes)
not afraid of inbreeding...
not interested in genetic progress...

Without local farmers - no local breeds!
Develop breeding scheme in cooperation with farmers

Is there room for selection for meat quality in local breeds?

Yes, with optimum contribution selection, there is room for selection also in a small population

Thank you!

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