

## ANIMAL GENETICS IN SPAIN

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### CATEGORY ANALYSIS

#### Cattle Genetics

In Spain, cattle genetics focuses on improving meat and milk productivity, disease resistance, and adaptation to diverse climates. Efforts include conserving native breeds and enhancing dairy and beef breeds using advanced technologies. Key organisations include FEAGAS and breeder associations.

- **Native Breeds:** Tudanca, Avileña-Negra Ibérica, and Retinta—valued for adaptation, sustainability, and meat quality.
- **Improved Breeds:** Holstein Fresian (main dairy breed), Charolais, and Limousin—used for high-yield meat and milk production.
- **Programs:** National Genetic Improvement Program and various R&D projects involving INIA, universities, and FEADER funding.

#### Swine Genetics

Spain is a global leader in swine genetics, focusing on productivity and meat quality. Native breeds like the Ibérico are prized in gastronomy, while improved breeds such as Large White and Landrace dominate commercial production.

- **Native Breeds:** Ibérico and Blanca Celta—important for biodiversity and tradition.
- **Improved Breeds:** Large White and Landrace—selected for growth rate, feed efficiency, and maternal traits.
- **Programs:** National improvement plans and biotech R&D projects with support from EU and national funds.
- **Key Organisations:** ANPS, AI centres like Porcisan and Genetiporc.

#### Sheep and Goat Genetics

Spain leads in sheep and goat genetic diversity and conservation. Native breeds support environmental sustainability, while improved breeds enhance meat production.

- **Sheep:** Native (Merina, Churra) and improved (Suffolk, Texel) breeds used for wool, milk, and meat.
- **Goats:** Native breeds such as Malagueña and Murciano-Granadina known for milk production in harsh environments.
- **Programs:** National and regional improvement and conservation initiatives.

- **Organisations:** Breeders' associations (e.g., ANCO, CABRAMA) and AI centres (OVIGEN, CAPROGEN).

### Poultry Genetics

Spanish poultry breeding focuses on efficient meat and egg production using commercial breeds (Hy-Line layers, Ross 308 broilers). Native breeds are being preserved for their unique traits.

- **Commercial Breeds:** Hy-Line and Ross 308 dominate the industry.
- **Native Breeds:** Prat and Euskal Oiloa—under conservation programs.
- **Programs:** National selection programs and applied genetics research targeting disease resistance and efficiency.

### Equine Genetics

Spain hosts numerous native horse breeds with historical and cultural importance. Programs support breed conservation and improvement for performance and utility.

- **Native Breeds:** Pura Raza Española, Gallega, Retuertas, Asturcón, Mallorquín, and Jaca Navarra.
- **Improved Breeds:** Hispano-Árabe, Hispano-Bretón, Hispano-Luso—for riding, work, and sport.
- **Research and Training:** Led by INIA, universities, and breeder associations (e.g., ANCCE), focusing on genetic improvement and sustainable practices.

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## SPAIN'S STRENGTHS IN ANIMAL GENETIC INNOVATION

Spain is advancing rapidly in animal genetics through cutting-edge research in biotechnology and genomics, positioning itself as a leader in the field. Key areas of innovation include:

### 1. CRISPR-Cas9 Gene Editing

Led by INIA, universities, and research centres, this precise gene-editing technique is used to improve disease resistance, productivity, and animal welfare.

- *Applications:* Disease resistance, enhanced feed efficiency, and reduction of harmful genetic traits.

### 2. Genomic Selection & Marker-Assisted Selection (MAS)

Genetic markers help select animals with desirable traits early in life.

- *Applications:* Better dairy and meat traits, early disease detection, and improved breeding decisions.

### 3. **Precision Genomics & Big Data**

Biotech companies are integrating genomics with big data analytics to optimise genetic improvement.

- *Applications:* Enhanced reproductive strategies, increased productivity, and sustainable resource use.

### 4. **Advanced Reproductive Biotechnologies**

AI centres, animal reproduction labs, and universities are developing embryo transfer, cloning, and sexed semen technologies.

- *Applications:* Rapid propagation of high-value genetics, conservation of native breeds, and sex control in livestock production.

### 5. **Omics Technologies (Proteomics, Metabolomics)**

These approaches study proteins and metabolites to complement genomic data.

- *Applications:* Animal health and nutrition, product quality enhancement, and new disease prevention strategies.

### 6. **Artificial Intelligence & Machine Learning**

Collaboration among academia and tech companies is enabling advanced data analysis in animal breeding.

- *Applications:* Genetic predictions, breeding optimization, and early detection of health issues.

### 7. **Development of Genetic Vaccines**

INIA, universities, and biotech firms are creating genetically engineered vaccines to protect livestock from infectious diseases.

- *Applications:* Better animal health, reduced antibiotic use, and enhanced animal welfare.

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## **FOREIGN MARKET**

### **Is Spain Ready for Animal Genetic Export?**

Yes—Spain has become a global leader in animal genetics, particularly in the swine and cattle sectors. Thanks to its advanced genetic improvement programs, Spain exports high-quality genetic material that boosts livestock productivity abroad.

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## WHAT IS EXPORTED & CUSTOMS CODES

Spain exports various forms of genetic material:

- **Semen:** Over 100,000 doses annually.
- **Embryos:** Thousands exported, especially from pigs and cattle.
- **Live Animals:** Over 1 million annually, especially pigs and cattle.
- **Oocytes, DNA, Somatic Cells:** Used in reproduction and cloning.

### Key Customs Classifications (Harmonised System):

- **Chapter 01:** Live breeding animals (equine, bovine, porcine, caprine).
- **Chapter 05:** Animal products not for human consumption (e.g., semen).
- **Subchapter 11:** Non-edible animal products (e.g., bones for embryo transfer).
- **Chapter 38:** Genetic materials like DNA.
- **Chapter 21:** Pharmaceuticals, including reproductive cells.

Classification depends on the product's state (e.g., frozen), intended use (research or vaccine production), and local regulations.

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## MAIN EXPORT MARKETS

- **EU:** Germany, France, Italy—benefit from EU trade agreements.
- **Latin America:** Mexico, Brazil, Argentina—high demand for genetic improvement.
- **Asia:** Especially China—major importer of Spanish swine genetics.
- **Africa:** Emerging markets seeking better livestock productivity.

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## EXPORT DATA BY SPECIES

### Cattle Genetics

- **Main Breeds:** Rubia Gallega, Asturiana de los Valles, Avileña-Negra Ibérica.
- **Exports:** 5,000 semen doses, 2,000 embryos, 10,000 live animals/year.
- **Opportunities:** Genomic innovation, adaptation to climate change.

### Sheep Genetics

- **Main Breeds:** Manchega, Churra, Merina.

- **Exports:** 3,000 semen doses, 1,000 embryos, 5,000 live animals/year.
- **Markets:** EU and North Africa.
- **Focus:** Disease resistance, emerging markets.

#### Goat Genetics

- **Main Breeds:** Murciano-Granadina, Malagueña.
- **Exports:** 2,500 semen doses, 800 embryos, 4,000 live animals/year.
- **Markets:** Europe, Latin America.
- **Goals:** Better product quality, system adaptability.

#### Swine Genetics

- **Exports:** 15,000 semen doses, 5,000 embryos, 20,000 pigs/year.
- **Markets:** EU, China, Japan, Mexico, Brazil.
- **Focus:** Feed efficiency, biotech innovation.

#### Equine Genetics

- **Main Breeds:** Pura Raza Española (PRE), Asturcón.
- **Exports:** 1,500 semen doses, 600 embryos, 2,500 horses/year.
- **Markets:** Europe, U.S., Mexico, UAE, China.
- **Challenges:** Preserving native breeds, enhancing sport performance.

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### Animal Genetics and Its Role in Sustainability

Animal genetics is playing a key role in making livestock production more sustainable. By improving animals' genetic traits, scientists and producers can create breeds that are more efficient, resilient, and environmentally friendly. Key contributions include:

- **Improved Feed Efficiency:** Genetically selected animals need less feed to produce the same amount of meat, milk, or other products, reducing the use of natural resources like land and water.
- **Lower Greenhouse Gas Emissions:** Genetic improvements can lead to animals that emit less methane, helping to combat climate change.
- **Better Adaptation to Harsh Environments:** Selecting animals with traits for heat tolerance, disease resistance, and stress resilience reduces the reliance on medications and inputs that may harm the environment.

- **Enhanced Product Quality:** Genetics can improve the quality of meat and dairy, leading to less food waste and greater consumer satisfaction.
  - **Biodiversity Conservation:** Genetic programs help preserve native and endangered breeds, which are often better adapted to local ecosystems and contribute to long-term sustainability.
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## Conclusions

Spain has become a global leader in animal genetics, especially in the **porcine and bovine sectors**, thanks to its advanced breeding programs and high-quality genetic exports. With a strong focus on **innovation** and **sustainability**, Spain is well-positioned to maintain and expand its role in the global animal genetics landscape.

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## SWOT Analysis – General Overview of Animal Genetics in Spain

### Strengths

- **Technological Advancement:** Use of cutting-edge tools like CRISPR-Cas9, genomics, and bioinformatics for precise genetic improvement.
- **Growing Demand for Food Safety:** Rising global demand for high-quality, safe animal products fuels investment in genetics.
- **Development of New Tools:** Genetic editing technologies allow for more accurate and efficient selection.
- **International Collaboration:** Sharing knowledge and resources through global cooperation enhances innovation.

### Weaknesses

- **High Costs:** Advanced technologies are expensive and often inaccessible in developing countries.
- **Regulatory Barriers:** Differences in GMO and biotech regulations between countries hinder global standardization.
- **Ethical Concerns:** Public resistance and ethical issues related to genetic modification remain significant challenges.
- **Knowledge Gap:** Limited transfer of technology and understanding between scientists and producers.

### Opportunities

- **New Applications:** Potential for genetics to aid in medicine production, organ generation, and biofuels.
- **Emerging Markets:** Developing countries offer growing demand for improved animal genetics.
- **Sustainability:** Genetics can support environmentally friendly and welfare-conscious production.
- **Product Personalisation:** Tailoring production to meet specific consumer preferences.

## Threats

- **Antimicrobial Resistance:** Overuse of antibiotics in livestock can lead to resistant bacteria, posing public health risks.
- **Climate Change:** Environmental stressors require animals adapted to new conditions, demanding further genetic innovation.
- **Emerging Diseases:** New diseases could threaten animal health and food security.
- **Economic Crises:** Financial instability can reduce investment in research and development.

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## Strategic Recommendations

To fully harness the potential of animal genetics while mitigating risks:

- **Invest in R&D** to advance genetic tools and applications.
  - **Promote international cooperation** to address global challenges collectively.
  - **Support education and training** for both researchers and farmers.
  - **Establish clear regulatory frameworks** ensuring ethical and safe practices.
  - **Enhance public communication** to build trust and understanding about the benefits of genetic technologies.
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