Breeding for morphological traits in the Lusitano horse:
So far and in the future

Lusitano Horse

- Main equine native breed from Portugal
  - Others are Sorraia, Garrano and Terceira ponies
- One of world’s oldest saddle horses!
- Considered in ancient times, by Greeks and Romans as the world’s best saddle horse
- Considered hotblooded horse
- Selected by the gineta combat
- Versatile, docile, agile, courageous
Historically very particular conditions, favorable to horse breeding, in southwest Europe:
- Last glaciation of Würm without full effect
- Continued contact with man husbandry

Historical records with thousands of years confirming the presence in the Iberian Peninsula of a fine horse, light, agile, hot-blooded
- with continuity lines, with fine head, long, dry, slightly convex, ...

Always indicated as fast (“son of the wind")
Skilled for superior riding and masterly fighting in the gineta type combat

Result of the selection of thousands years as a horse for fieldwork, hunting and fighting:
- wars, cattle herding, fighting the gineta

It is the archetype of the Baroque horse
- very typical and harmonious model, endowed with extreme courage, but at the same time, docility and sociability
- recognized long ago as one of the world’s best saddle horses
Combining good temper and mental with easy and light movements and ability to collect
Distribution of the breed

- Around 4000-5000 breeding mares all over the world, distributed by (APSL, 2016):
  - Portugal (1800-2000)
  - Brazil (1000-1200)
  - France (500-600)
  - Remaining in several other countries (GER, MEX, SPA..)
- Breed considered endangered by FAO (< 5000♀)
- Main export and promotion product of rural areas from Portugal, alongside with wine, olive oil and cork

Lusitano world dissemination

Births of Lusitano horses in 32 different countries

- Presence and use much wider around the globe
- 20 foreign associations
### Functional skills of the Lusitano

- **Outstanding versatility:**
  - Bullfighting
  - Dressage
  - Carriage
  - Working Equitation
  - Portuguese Equitation
  - Showjumping
  - Horse-ball
  - Vaulting
  - Eventing
  - TREC
  - Equestrian art
  - Fieldwork
  - Cinema
  - Conformations comp.
  - Beauty comp., ....

### Selection constraints for Lusos

- **Selection intensity**
  - Few candidates for selection
  - Big proportion of selected sires and dams
    - ~ 5 active broodmares/stallion
    - No registered offspring/♂ ~ 13.13 ± 22.53 horses
    - Limited use of AI
  - Long generation intervals
    - Males ~ 11.3 years
    - Females ~ 9.7 years
    - Some advantage in terms of inbreeding
Selection constraints for Lusos

- Genetic diversity
  - Affected by inbreeding (closed studbook)
    - Mean Fx ~ 11% (Individuals with Fx > 50%)
    - Some studs with Fx > 30%
  - Only 2 ancestors explain more than 30% of the genetic diversity:
    - Agareno (MV) and Solo
  - Narrow base of selection

Morpho-functional Grading (since 1967)

- Traits in a morpho-functional grading:
  - Not approved with one 4, two 5 or three 6
  - Additionally also:
    - Height at Withers
    - Digital photo
    - Spermogram

<table>
<thead>
<tr>
<th>TRAITS</th>
<th>Coeff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Partial</td>
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<tr>
<td>Neck</td>
<td>Partial</td>
</tr>
<tr>
<td>Shoulders &amp; withers</td>
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<tr>
<td>Chest &amp; ribcage</td>
<td>1</td>
</tr>
<tr>
<td>Back &amp; loins</td>
<td>1,5</td>
</tr>
<tr>
<td>Croup</td>
<td>1</td>
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<tr>
<td>Legs</td>
<td>Front</td>
</tr>
<tr>
<td></td>
<td>Hind</td>
</tr>
<tr>
<td>Overall Impression</td>
<td>1,5</td>
</tr>
<tr>
<td>Gaits</td>
<td>Walk</td>
</tr>
<tr>
<td></td>
<td>Trot</td>
</tr>
<tr>
<td></td>
<td>Canter</td>
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<tr>
<td>TOTAL SCORE</td>
<td>10</td>
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</table>
• Analyses of morphological and functional characteristics on the Lusitano horse with a BLUP Animal Model
  ▪ Estimates of:
    ✓ Fixed effects: Genetic parameters
    ✓ Predicting Genetic Values
    ✓ Genetic trends over time
  1) For morphological characteristics
    ▪ 7 body regions, gaits, total score and height at withers (10 traits)
  2) Additionally also for functional traits in:
    ▪ Dressage
    ▪ Working Equitation

M&M – Model Used

• Estimates of genetic parameters:
  ▪ $h^2$, correlations and genetic values
    ✓ Uni and bivariate analysis using MTDFREML software
    (Boldman et al., 1995)

Morphology analysis model:
  ▪ File with 18148 graded animals (1967 to 2009)
    ✓ 18076 TS; 17139 partials; 16955 HW

Mixed model with single record
### Results

#### Descriptive Statistics for Morphology:

<table>
<thead>
<tr>
<th>TRAIT</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>CV(%)</th>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
<td>Height at Withers (cm)</td>
<td>16955</td>
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<td>7.24</td>
<td>0.81</td>
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<td>7.17</td>
<td>0.71</td>
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<td>0.78</td>
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</tr>
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</table>

#### Heritability & Genetic SD ($\sigma_A$)

<table>
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<tr>
<th>TRAIT</th>
<th>$h^2$±SE</th>
<th>$\sigma_A$</th>
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<tbody>
<tr>
<td>Height at Withers</td>
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<td>Head and Neck</td>
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<td>Shoulder &amp; Withers</td>
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<td>0.22 pts</td>
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<tr>
<td>Chest &amp; Ribcage</td>
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<td>Back &amp; Loins</td>
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<tr>
<td>Croup</td>
<td>0.14±0.014</td>
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<tr>
<td>Legs</td>
<td>0.07±0.012</td>
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<tr>
<td>Overall Impression</td>
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<tr>
<td>Gaits</td>
<td>0.16±0.015</td>
<td>0.42 pts</td>
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</table>
I.1 (A. Andrade Vicente)
Since 2017:
Implementation of Linear Profiling in the Lusitano

Conformation profiling 0-40 scale (5 points interval)

After several studies: recommendation to breeders association for more objective data

Linear Profiling in the Lusitano

Conformation profiling: LEGS

Gaits profiling: walk, trot, canter
Conclusions for morphology

- Lots of data available
  - For more than 50 years
- Estimation of genetic values
  - Possible for all animals
  - Significant differences in genetic merit
  - Good precision and possibility of selection
- Genetic evaluation available for all breeders
- Implementation of the Linear Profiling (since 2017) to support selection decisions

References

- http://www.horseselection.com
- http://www.cavalo-lusitano.com