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Ridge gene test: Its use and potential

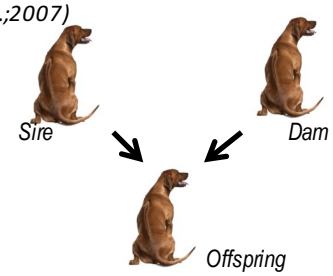
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Brno, Czech Republic

Rhodesian Ridgeback World Congress
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Ridge Genetics

Ridge in Rhodesian Ridgebacks is caused by specific mutation:
~ 133.000 DNA base pairs duplication on canine chromosome 18 = „Ridge gene“
(Salmon Hilbertz, et al.;2007)



Dog might have:
- 2 mutations (duplications; ridge genes) = „R/R“ (*dominant homozygote*)
- 1 mutation (duplication; ridge gene) = „R/r“ (*heterozygote*)
- no mutation (duplication; ridge gene) = „r/r“ (*wild type)*

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Ridge Genetics

Ridge formation is caused by presence of single mutation (duplication, ridge gene) = **dominant genetic trait**

Dog might be:

ridged – R/R (=2 mutations, mutation on both chromosomes) –passes ridge gene to all puppies

- R/r (1 mutation on one chromosome, no mutation on another chromosome) – passes mutation only to 50% of puppies – *flip of coin*

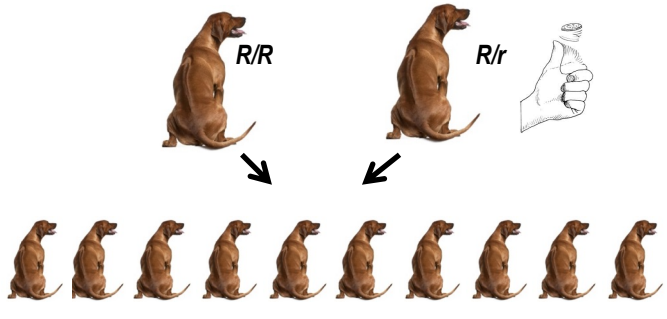


ridgeless - r/r (no mutation on both chromosomes) = passes „no mutation“ to all puppies

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Ridge Genetics

Mating combination RR x Rr



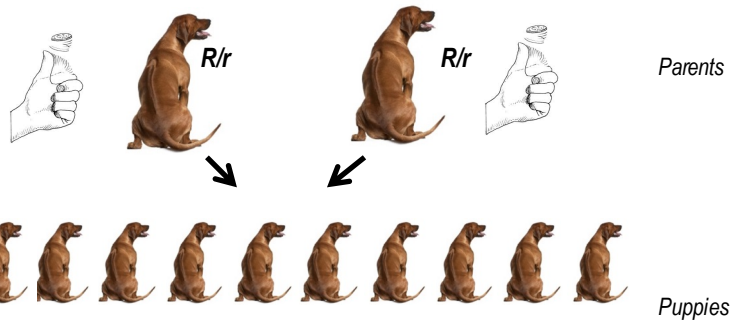
50% R/R + 50% R/r

All puppies expected to be ridged!

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Ridge Genetics

Mating combination Rr x Rr



25% R/R + 50% R/r + 25% r/r

25% puppies expected to be ridgeless!

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Ridge gene test

Based on physical appearence not possible to distinguish between:
RR – 2 ridge genes and Rr – 1 ridge gene

On several breeders´ requests
- **development of genetic test for ridge disposition** (= copy number of ridge genes)
  Veterinary Research Institute, Brno, Czech Republic
  from 8/2014



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Ridge gene test

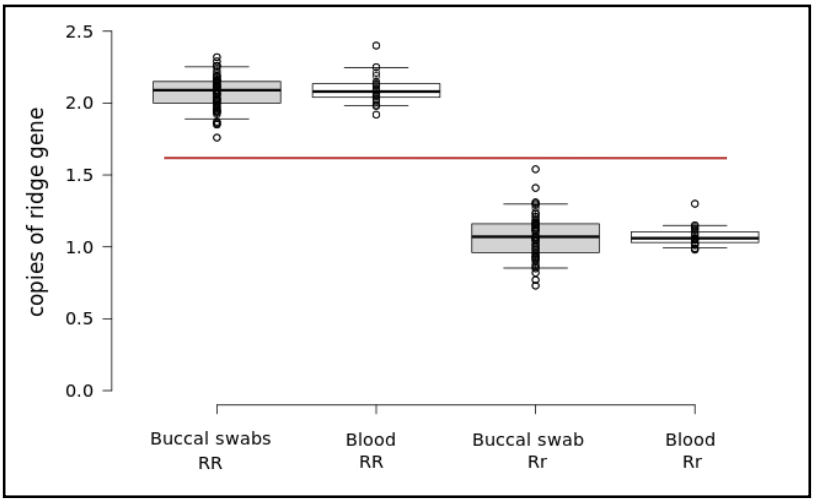
- molecular genetic test for copy number of ridge gene = detection of duplications
  result = no ridge gene – rr; 1 ridge gene – Rr; 2 ridge genes – RR

- **Quantitative fluorescent PCR test** based on treshold values

Dog sample:
- blood or buccal swab samples



Ridge gene test



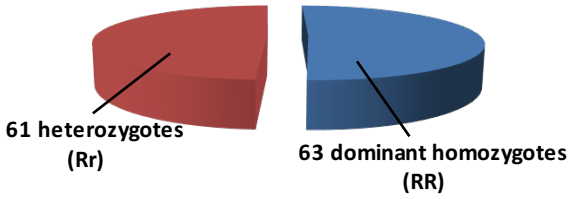
- blood sample: **test accuracy >99%,** (100% analysis success rate)
- buccal swab sample: **test accuracy >96%,** (~80% analysis success rate)

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Ridge gene test

- more than 200 samples analysed (commercial + research samples)

124 unrelated dog samples



~75% buccal swabs and 25% blood samples

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Ridge gene test – surprising finding

- Some sires or dams with 2 ridge genes (RR) produced ridgeless puppies!

<u>Example 1:</u>
A stud dog (RR) produced 15 litters
- in 14 litters all puppies ridged
- in 1 litter two ridgeless puppies
Stud dog retested –RR confirmed
both ridgeless puppies tested – both Rr



<u>Example 2:</u>
A dam (RR) produced 16 puppies in 1 litter
- 15 pupies ridged, but 1 was ridgeless
Dam retested – RR confirmed
ridgeless puppy tested – Rr!

<u>We genetically confirmed 4 (Rr) ridgeless animals</u>

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Ridge gene test – surprising finding

- Dataset analysis (in collaboration with Stephanie Muller – founder of Ridgeback International Database)

RR x Rr mating (confirmed by ridge gene test)
- in total 229 puppies born
- 9 puppies ridgeless

- RR x Rr mating produces ridgeless puppies in 3.9% (9/229)
- RR x RR mating never produced ridgeless puppy

Ridge gene might be silenced (suppresed) occassionally!

Ridge genetics is not governed by simple dominant inheritance, but rather incomplete penetrance model!

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Ridge gene test – research samples

- Focus on Dermoid sinus and ridge abnormalities

Dermoid sinus – ridge gene is predisposing genetic factor
Dominant homozygotes (RR) ~5x increased risk for DS
(Salmon Hilbertz, et al.;2007)

- In our laboratory we confirmed occurrence of DS predominantly in dominant homozygotes (RR)

We request samples of dogs with DS for research

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Ridge gene test – research samples

- ridge abnormalities
  - short (partial) ridge
  - mutliple crowns,
  - offset crowns
- We tested several Ridgebacks with multiple crowns – all homozygous (RR)



We request samples of dogs with ridge abnormalities

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Summary I

Genetics in Rhodesian ridgeback breeding			
Parents (Sire x Dam)	Puppies		
	ridged	ridgeless	risk of Dermoid sinus
RR x RR	100%	0%	increased
RR x Rr or Rr x RR	>90%	<10%	normal
Rr x Rr	75%	25%	normal / low
RR x rr or rr x RR	>90%	<10%	low
rr x rr	0%	100%	very low

RR – dominant homozygote (2 ridge genes), RR puppy is always ridged
Rr – heterozygote (1 ridge gene), Rr puppy is in 90% ridged, in approx. 10% ridgeless (ridge gene is suppressed)
rr – ridgeless (no ridge gene)

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Summary II

- **We developed and validated sensitive ridge gene test for commercial and research use (more info at www. genocan.eu)**
- **The ridge gene (133.4 kb duplication) predispose to ridge formation with incomplete penetrance**
  - ridgeless dogs occasionally carry „silenced" ridge gene (Rr)
  - approximatelly 8% of heterozygotes (Rr) might be ridgeless (deduced from RR x Rr mating)
- **Dominant homozygotes (RR) are predisposed to DS occurence and very likely to some ridge abnormalities (multiple crowns)**

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Acknowledgements:

- Nicolette Salmon Hillbertz *et al.*, Upsala University, Sweden



Duplication of *FGF3*, *FGF4*, *FGF19* and *ORAOV1* causes hair ridge and predisposition to dermoid sinus in Ridgeback dogs

- Czech Rhodesian Ridgebacks Breeding Club (KCHRR) (Sarka Stusakova – Head of advisers to breed)
- Ridgeback International (Stephanie Muller)