How nutrition can influence breeding performances in dog?

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Photo garçon
What does it mean « good breeding performances »?
Good breeding performances if.....

- Good semen quality
  - Good mobility
  - High concentration
  - Normal morphology

- Good ovocyte quality
  - High number of ovocytes

A lot of **healthy** puppies with a healthy mother

- No embryonic death
- No foetal death
- No dystocia
- Healthy female
  - Good body condition
  - Good milk (quality + quantity)
- No neonatal death
- Good birth weight
- Optimal growth
- Healthy puppy

A lot of healthy puppies with a healthy mother

- Healthy puppy
- Healthy female
- Good birth weight
- Optimal growth
- Healthy puppy
How food can influence breeding performances?
How food can influence breeding performances?

### Ingredients

<table>
<thead>
<tr>
<th>Intentionally introduced substances</th>
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<tbody>
<tr>
<td><strong>Nutrients</strong></td>
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### Diet

- Nutrient profiles
- Quantity

### Storage

- Temperature
- Humidity
- Packaging
- Time
- Cleanliness
- Insects, rodents

### Animal

- Digestion
- Absorption
- Nutritional needs
- Maintenance
- Reproduction
  - Oestrus
  - Gestation
  - Lactation
  - Growth
  - Semen quality

### Formulation Process

- Formulation
- Process
- Ingestion
Link between food and breeding performances

- Quality
- Food
- Quantity

Decrease  No effect  Improve

Breeding performances
Link between food and breeding performances

- **Food Quality**: Decrease → No effect → Improve
- **Food Quantity**: Decrease → No effect → Improve

Breeding performances
Good breeding performances if.....

Nutrition

Environment
Genetic
Stress
Behavior
Management of reproduction
Breed
Infectious disease
Age
How to optimize breeding performances

Optimal kennel management + Optimal nutrition = Best results
How to define the optimal diet?
How food can influence breeding performances?

Ingredients

Intentionally introduced substances
- **Nutrients**
  - Fat/Proteins/Carbohydrates/Vitamins/Minerals
- **Food additive**
  - Preservative, flavors

Unintentionally introduced substances
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Diet

Nutrient profiles

Quantity

Storage

- Temperature
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Animal

Digestion

Absorption

Nutritional needs

Maintenance, Reproduction

- Oestrus
- Gestation
- Lactation
- Growth
- Semen quality

Formulation

Process

Ingestion
**Body Condition Score - Medium Dog**

**Too Thin**
1. Ribs, lumbar vertebrae, pelvic bones and all bony prominences evident from a distance.
2. No discernible body fat.
   - Obvious loss of muscle mass.
3. Ribs, lumbar vertebrae, and pelvic bones easily visible.
   - No palpable fat.
   - Some bony prominences visible from a distance.
   - Minimal loss of muscle mass.

**Ideal**
4. Ribs palpable with minimal fat covering.
   - Waist easily noted when viewed from above.
   - Abdominal tuck evident.
5. Ribs palpable without excess fat covering.
   - Waist observed behind ribs when viewed from above.
   - Abdomen tucked up when viewed from side.

**Overweight**
6. Ribs palpable with slight excess of fat covering.
   - Waist is discernible when viewed from above but is not prominent.
   - Abdominal tuck apparent.

**Too Heavy**
7. Ribs palpable with difficulty, heavy fat cover.
   - Noticeable fat deposits over lumbar area and base of tail.
   - Waist absent or barely visible.
   - Abdominal tuck may be absent.
8. Ribs not palpable under very heavy fat cover or palpable only with significant pressure.
   - Heavy fat deposits over lumbar area and base of tail.
   - Waist absent.
   - No abdominal tuck.
   - Obvious abdominal distension may be present.
   - Waist and abdominal tuck absent.
   - Fat deposits on neck and limbs.
   - Obvious abdominal distension.
Leptin: a peptide hormone secreted by adipocytes
Leptin concentration is correlated to BCS and fat level

Obesity induces modifications in hormonal secretions

- GnRH
- FSH, LH
- Progesteron
- Estrogen
- Leptin
Obesity induces an inflammation of placenta in human

Obesity

General and local inflammation

Hormonal dysregulation

Infertility
Brannian JD et al. Baseline non-fasting serum leptin concentration to body mass index ratio is predictive of IVF outcomes. Human reproduction, 2001, 16, 9 : 1819-1826
New study done in dog on BCS and reproduction

- **Mating (W0)**
- **Gestation (W4)**
- **Whelping (PP)**
  - Birth

- **Body condition score + Leptinemia**

- **n=41 bitches (n=34 pregnant)**

- **Low birth weight**
  - (25% lowest weights)

- **n=179 puppies**

- **Perinatal mortality**
  - (0-2 days)
BCS influence prevalence of low birth weight and mortality

**Prevalence of low birth weights**

22.5%

**Perinatal mortality**

25.1%

Low birth weight puppies (%)

Mortality (0-2 days) (%)
Overweight bitches accumulate fat in the uterus

Uterus has a muscle: myometra
In overweight women, a diminution of myometra contraction is observed.

Overweight is frequent in pure breed dogs

- **Holland (Winner show)**
  - 1379 dogs*
  - 19 %

- **UK (Crufts)**
  - 960 dogs**
  - 26 %

- **France and Belgium (world dog show)**
  - 482 dogs***
  - 23 %

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**Such, ZR., German, AJ. (2015) Best in show but not best shape: a photographic assessment of show dog body condition. Veterinary Record 177, 125.

***Unpublished results
Assessment of body condition score before the mating

Only healthy dogs in a good body condition score should be used for breeding
How to feed the dog during pregnancy?
Foetal growth occurs at the end of pregnancy.
Energy needs of the bitch increase from the 6th week of gestation

% MER

0 100 110 120 130 140 150
0 7 14 21 28 35 42 49 56 63

In the same time, food intake capacity is decreasing

• Uterus compresses the stomach

• Behavioural changes
Necessity to use a palatable food with a high energy level

Avoid unlimited food distribution during gestation!

- Foetal growth
- Ingestion capacity
- Behavioural changes

High energy food
Palatable

Good practice
Optimal weight of pregnant bitches

G gross = weight (just before delivery) – Weight (pre-mating) = 15 – 25 %

G net = weight (post-delivery) – weight (post mating) = 5 – 10 %

How food can influence breeding performances?

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<td>Temperature</td>
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Formulation Process

Ingestion

Digestion
Absorption

Nutritional needs

Maintenance Reproduction

Neocare
Cleft lip and palate
Cleft palates: a main concern in dogs

Prevalence (1-2)
4.2 – 17.6 %

2- Elwood JM. et al. New Zealand Veterinary Journal, 1997 (45) 6 : 254-256
Cleft palate affects many dogs breeds
.... But mainly brachycephalic breeds
Cleft palate: gestion and treatment

- Oral mucosa
- Periosteum
- Nasal cavity
In Humans, supplementation with folic acid decreases the risk of cleft palate

Review of 5 trials
= 6105 women

**Authors’ conclusions**—Folic acid, alone or in combination with vitamins and minerals, prevents NTDs but does not have a clear effect on other birth defects.

400 μg of folic acid / day / woman

5 mg of folic acid / day / woman
A low folate concentration is frequent in dog

1990 – 2002

9960 dogs from 40 breeds

14 %
Low folate concentration

45 reproductive bitches presented for a heat follow up

11 %


** Grellet A et al. A high folic acid diet increases folate serum concentration in pregnant bitches. EVSSAR congress 2014. Wroclaw, Poland
Folic acid during early gestation reduces the incidence of cleft palate

Elwood JM. et al. New Zealand Veterinary Journal, 1997 (45) 6 : 254-256

Del Carro et al. EVSSAR congress 2014. Wroclaw, Poland
Two ways to increase serum folic acid level

Two ways to increase folic acid level

Grellet A et al. A high folic acid diet increases folate serum concentration in pregnant bitches. EVSSAR congress 2014. Wroclaw, Poland
Folic acid and cleft palate... BUT don’t forget the other causes

→ Collaboration with vets

→ Selection of dogs by breeders
Eclampsia

Clinical signs in case of eclampsia

- Muscle tremors, fasciculations
- Generalized seizures
- Muscle cramping or pain
- Behavior changes
- Poor activity

Low blood Calcium concentration
Extracellular calcium ($\text{Ca}^{2+}$)

Parathyroid hormone (PTH)

Soft tissue calcium
Extracellular calcium (Ca\(^{2+}\))

Parathyroid hormone (PTH)

Ca\(^{2+}\)

Lactation
Risk factors of eclampsia

1- Calcium supplementation during gestation
**Risk factors of eclampsia**

1- Calcium supplementation during gestation

2- Low quality diet

3- High quantity of legumes (phytates)

Parathyroid hormone (PTH)

Extracellular calcium (Ca$_2^+$)

Low

Soft tissue calcium

Ca$_2^+$
Prevention of eclampsia

High quality balanced diet

No calcium supplementation during gestation
Does a supplementation in folic acid increase the blood level?
Recent publication: supplementation in folic acid goes through the blood

A diet with a high folic acid level increase the blood folic acid level

Diet 1
Folic acid = 3.8 mg/kg

Diet 2
Folic acid = 17.6 mg/kg

Blood folic acid

14.1

25.7

X 1.8
Does folic acid supplementation decrease frequency of cleft palates?
What does it mean an «optimal reproduction»?

<table>
<thead>
<tr>
<th>Male</th>
<th>Mating</th>
<th>Gestation</th>
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<tr>
<td>Good semen quality&lt;br&gt;&lt;i&gt;Mobility&lt;/i&gt;&lt;br&gt;&lt;i&gt;Concentration&lt;/i&gt;&lt;br&gt;&lt;i&gt;No anomaly&lt;/i&gt;&lt;br&gt;&lt;i&gt;Fertile&lt;/i&gt;</td>
<td>A visible oestrus&lt;br&gt;A lot of ovocytes&lt;br&gt;A good ovulation</td>
<td>An healthy female&lt;br&gt;Healthy foetuses&lt;br&gt;An easy parturition</td>
<td>An healthy female&lt;br&gt;Good milk&lt;br&gt;&lt;i&gt;High quantity&lt;/i&gt;&lt;br&gt;&lt;i&gt;High quality&lt;/i&gt;</td>
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<tr>
<td>Female</td>
<td></td>
<td></td>
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<tr>
<td>Neonates</td>
<td></td>
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<td></td>
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<tr>
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<td>Healthy neonates&lt;br&gt;An optimal birth weight&lt;br&gt;An optimal growth</td>
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How to define the optimal diet?

Diet

Nutrient profiles

Quantity

Storage

Temperature
Humidity
Controled Atmosphere
Migrants from Packaging Materials

Animal

Nutritional needs

Digestion
Absorption

Maintenance Reproduction

Oestrus
Gestation
Lactation
Growth
Semen quality

Intentionally introduced substances

Food ingredients

Food additive
Preservatives
Flavors

Nutrients

Enrichment
(Vitamins and mineral)

Fortification
(other nutrients)

Unintentionally introduced substances

Biological
Mycotoxins
Viruses
Parasites
Bacteria

Chemical
Pesticide residues
Veterinary drug residues
Environmental contaminants
(PCB, dioxins...)

Formulation

Processing

Ingestion
Good breeding performances if....

Nutrition

Environment
Genetic
Stress
Behavior
Management of reproduction
Breed
Infectious disease
Age
The two main causes of infertility

50%
Factor influencing reproduction

- Infectious diseases
  - Age
  - Behavior
  - Nutrition

- Infectious diseases
  - Age
  - Behavior
  - Nutrition

- Mating time
  - Stress

The male dog

The female dog

Management

Reproduction
What we are going to see

Nutrition

- Fertility
- Gestation
- Whelping
Impact of nutrition in the prevention of cleft palate
Impact of nutrition in the prevention of cleft palate

Nutrition

Fertility

Gestation

Whelping
Impact of nutrition in the prevention of cleft palate

Nutrition

Fertility

Gestation

Whelping
Assessment of body condition score during the gestation

It is important to control the weight gain during gestation of bitches
How to feed a bitch during gestation?
Physiological modifications during gestation

- Gestation
  - Fœtal growth
    - Weight gain
    - Energy requirements
    - Food intake
  - Adaptation of the diet
Physiological modifications during gestation

Fœtal growth

Weight gain
Clinical study on the follow up of bitches during their gestations

Dr. Alain Fontbonne  Dr. Cindy Maenhoudt  Dr. Natalia Santos  Dr. Paolo Borges
The average bitch will gain from 15 to 25% of her prebreeding weight prior the whelping.

Average weight gain since ovulation (%)

- Embryo = Organs formation
- Fœtus = Growth

Day post ovulation

0 5 10 15 20 25 30 35 40 45 50 55 60 65

15 – 25%
Physiological modifications during gestation

- Fœtal growth
  - Energy requirements
Energy needs increase from the 6th week of gestation

Physiological modifications during gestation

- Fœtal growth
  - Weight gain
  - Energy requirements
  - Food intake

[Diagram with arrows and boxes indicating the flow of information]
Daily food consumption increases during gestation

At the same time, food intake capacity is decreasing

- Uterus compresses the stomach
- Behavioural changes
Physiological modifications during gestation

Gestation

Fœtal growth

- Weight gain: 15 – 25 % during gestation
- Energy requirements: 30 – 60 % during gestation
- Food intake: Some periods of appetite reduction
Physiological modifications during gestation

Gestation

Fœtal growth

Adaptation of the diet
Necessity to use a palatable food with a high energy level

- High energy food
- Foetal growth
- Ingestion capacity
- Palatable
- Behavioural changes
- Number of meals
Take home message

Nutrition

- Fertility
- Gestation
- Whelping

Optimal body score
Folic acid
High energy
Palatable
Milk production
In Carnivores, there are two strategies to produce milk.
To understand those two strategies, we can compare the bodyweight evolution during pregnancy.
In Carnivores, there are two strategies to produce milk.

- **More energy reserve**
  - Energy comes from body fat deposit & food

- **Few energy reserve**
  - Energy comes only from food
Food is the only fuel to cover energetic needs of lactating female dogs
It is like if the mother could run 60 km per day
Do you have to control the rationing during the lactation?
Lactating female

• NOW, it’s the time for unlimited kibble distribution!

© internet
http://macleans.files.wordpress.com/2009/01/rtr23s7h.jpg
Lactating female

• Control amount of food per day if:
  • Little litter
  • Bulimic female
  • Congestive mastitis
Nutrition of neonates

Milk of the mother

Industrial milk
Nutrition of neonates

Milk of the mother

Factors influencing milk composition

Colostrum and immunity
What are the main factors influencing the quantity and quality of milk?

- Litter size
- Stage of lactation
- Quantity and composition of milk
- Diet
- Teat position
Litter size has an impact on the milk yield


- 2 kittens
- 3-4 kittens
- 6 kittens

% Milk yield depending on the female BW

Number of weeks of lactation

2nd week

6th week
Litter size has an impact on the composition of milk.

% of fat in the milk

- 2 kittens: 13.6%
- 3 kittens: 14.2%
- 4 kittens: 16.3%
- 5 kittens: 12.6%
- 6 kittens: 8.9%

Diet and number of weeks of lactation have an impact on the composition of cat milk.

Lactose concentration is higher in back teats than in front teats

Conclusion

• In order to adapt energy intake:

  • Selection of the nutritional profile depending on:
    • The physiological status
    • Dogs activity
    • Dog size

  • Measure:
    • Quantity of food distributed to dogs
    • Weight of the dogs