

# Session 48: Sheep and goats

## Free communications


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**Ash and protein deposition patterns in the body of Saanen goats**

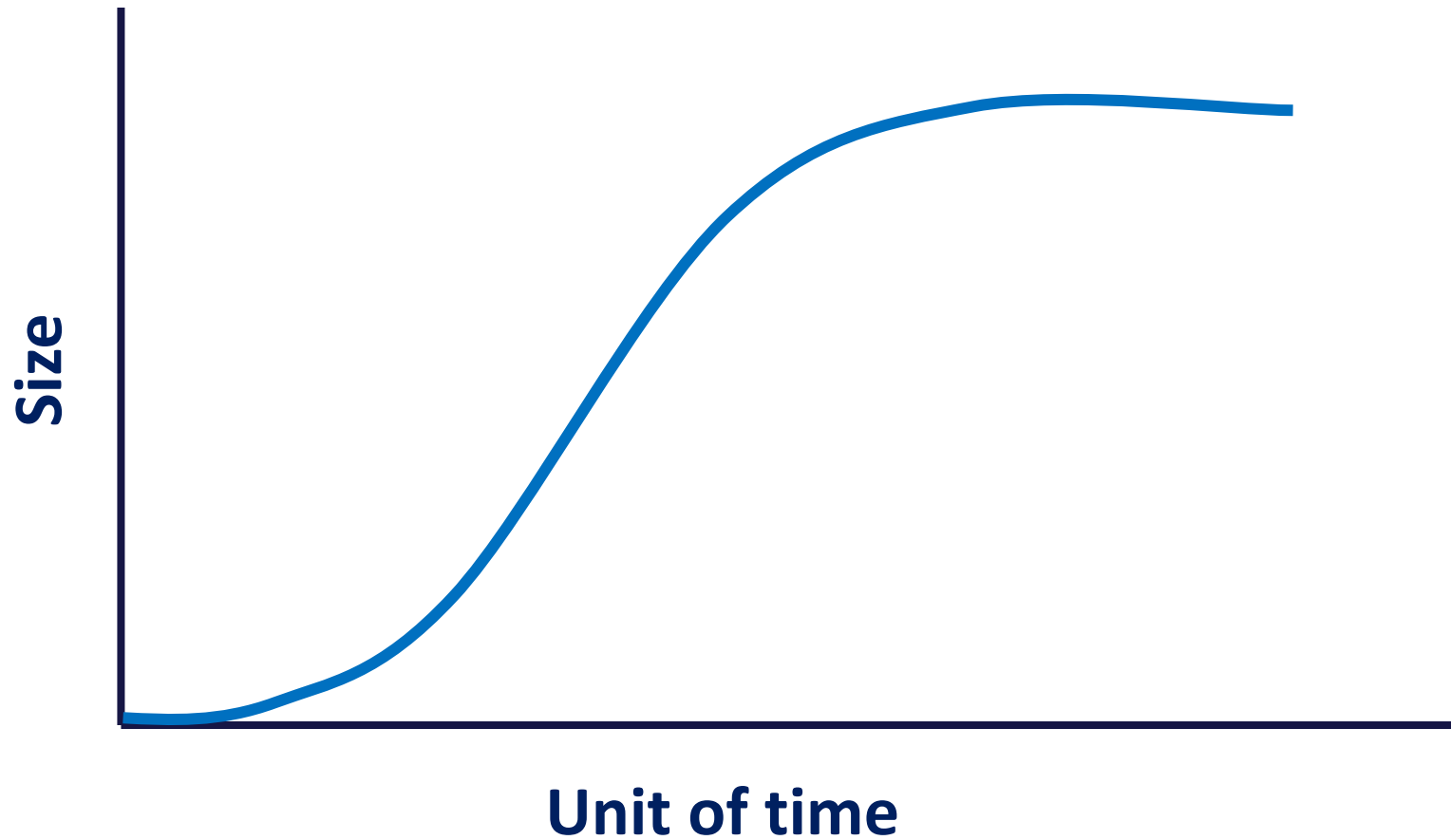
**Mature size of Saanen goats**



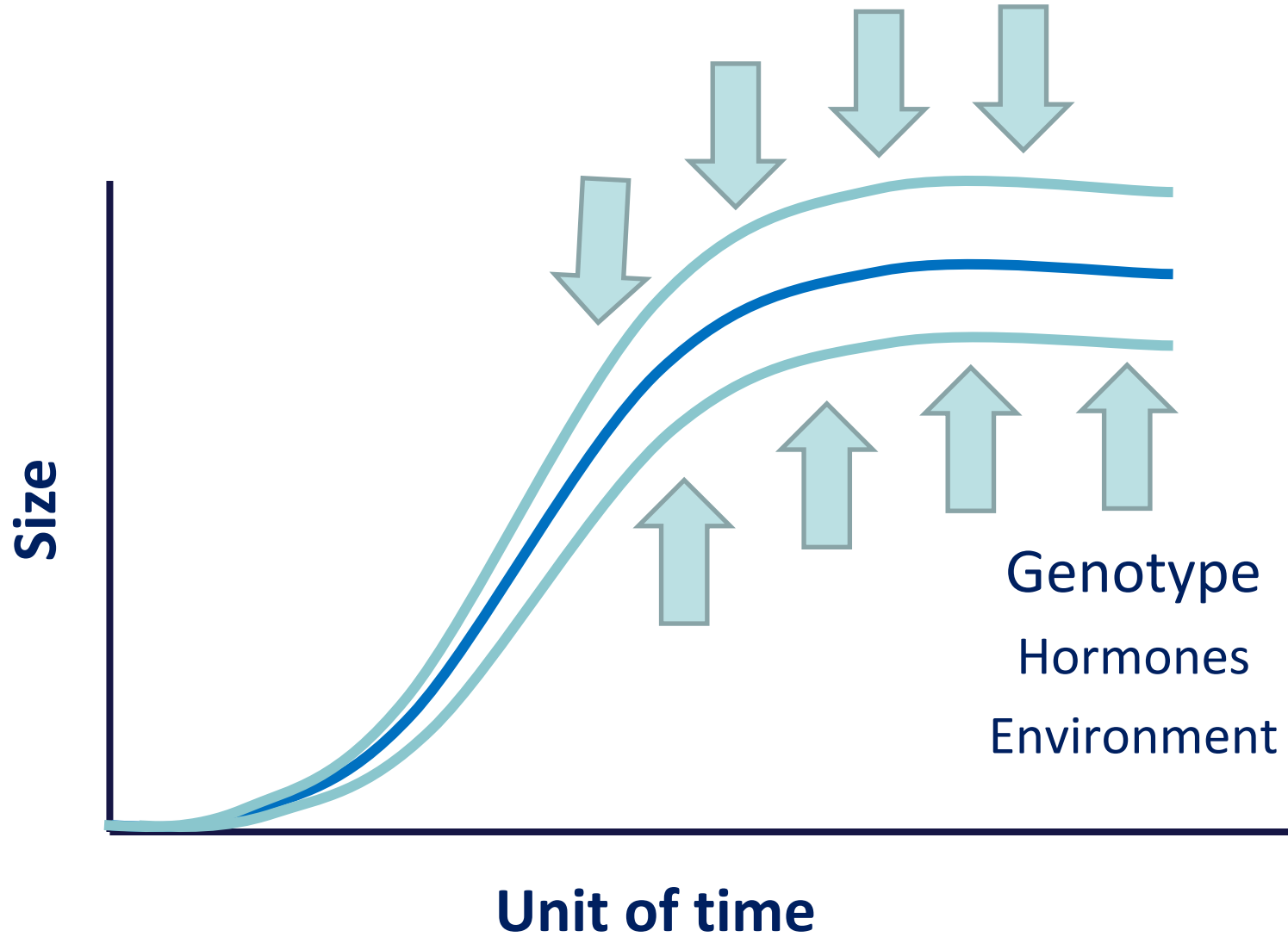
# Ash and protein deposition patterns in the body of Saanen goats

# Background

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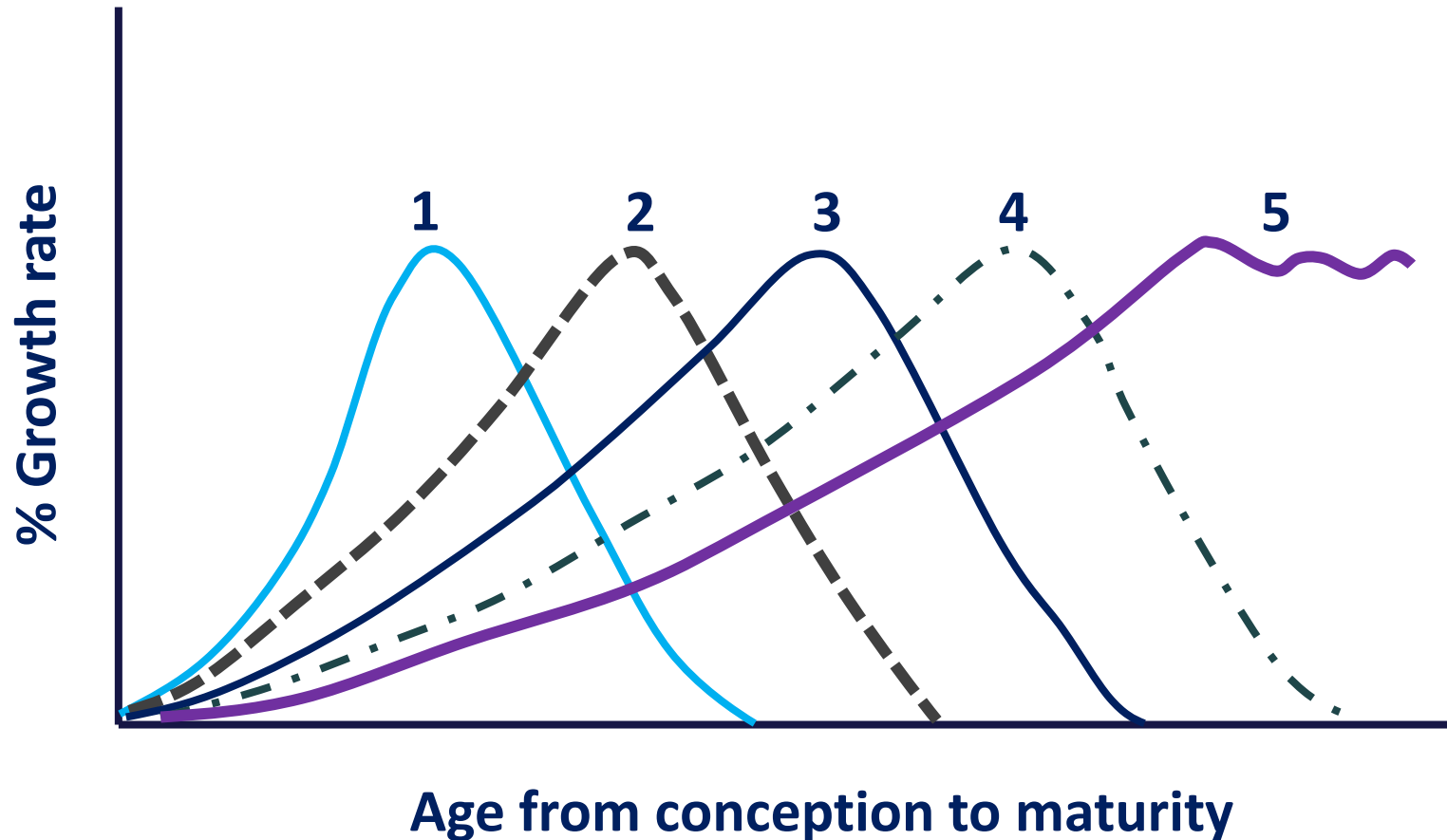


Conceptual model of animal growth.



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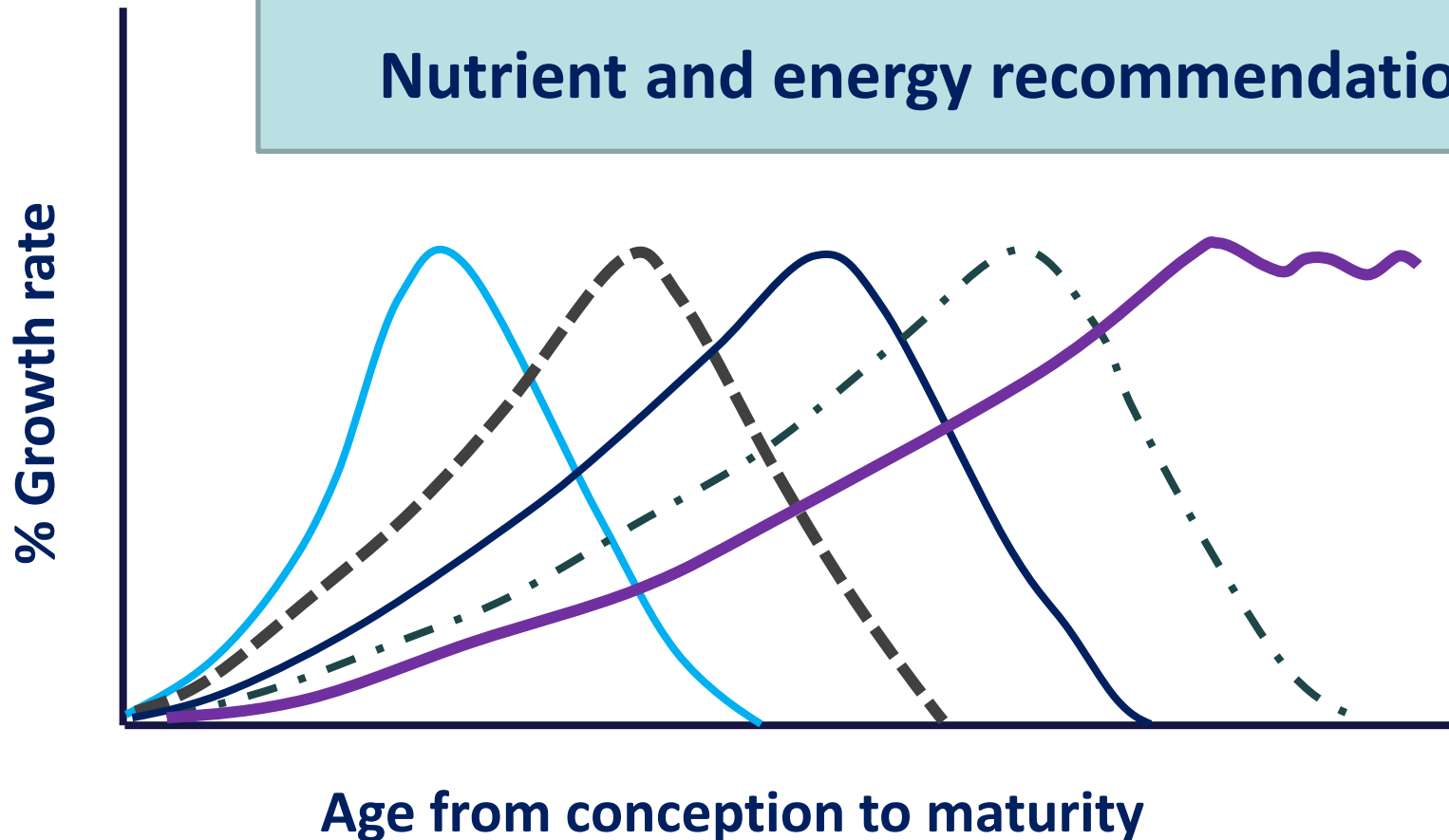
# Background



Waves of growth: 1 – nervous tissue; 2 – bone; 3 – muscle; 4 – fat; 5 – daily feed intake (Lawrence and Fowler, 2002)

# Background

Intake and performance (ADG) prediction  
Nutrient and energy recommendation



# Objective

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**Meta-analysis** → to fit a **growth curve** that describes the increase of **protein** and **ash** contents in empty body mass (**EBM**).





## Database (5 studies)

***Individual records:*** 76 female Saanen goats

Diet: dehydrated corn plant or Tifton hay, ground corn, soybean meal, soybean oil, limestone, mineral supplement and ammonium chloride

**16.6 ± 1.9% of CP and 4,172.5 ± 278 kcal/kg of GE (DM basis).**

# Statistical analysis

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## Selection of candidate equations

Preliminary graphical examination

Brody, Gompertz, Logistics, Von Bertalanffy and Richards

Fitted using a **nonlinear mixed model** methodology (SAS macro %NLINMIX; SAS Inst. Inc., Cary, NC; v. 9.4).

Between-study variability

$u_1$ ,  $u_2$  and  $u_3$  to the  $\beta_0$ ,  $\beta_1$  and  $\beta_2$  parameters.

# Results and discussion

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## Gompertz growth function

$$CP \text{ or } Ash = (\beta_0 + \mathbf{u}_1) \times \exp^{(\beta_1 + \mathbf{u}_2) \times (1 - \exp^{-(\beta_3 + \mathbf{u}_3) \times EBM})} + e$$

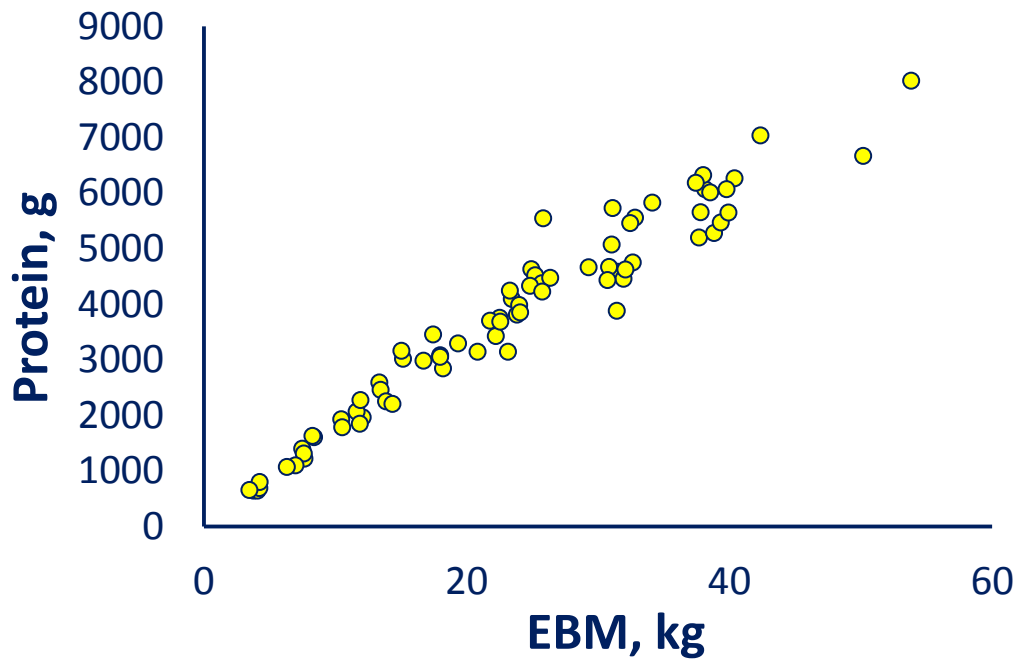
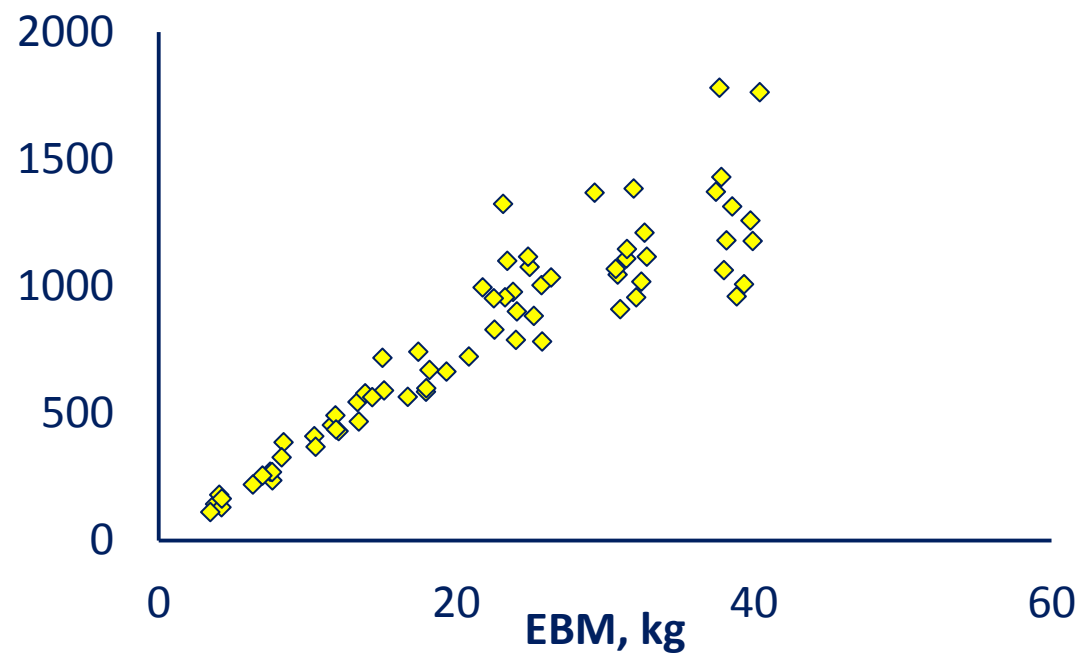
# Descriptive statistics of the database

Variable	n	Mean	SD	Min.	Max.
Age, d	76	227.0	126.5	18.0	585.0
DMI, g/d	76	743.6	333.5	270.5	1528.2
BM, kg	76	25.7	11.9	4.6	59.4
EBM, kg	76	22.1	11.1	3.5	53.3
Ash, g	76	850.2	461.6	111.7	2356.5
Protein, g	76	3480.9	2014.8	689.9	8638.5

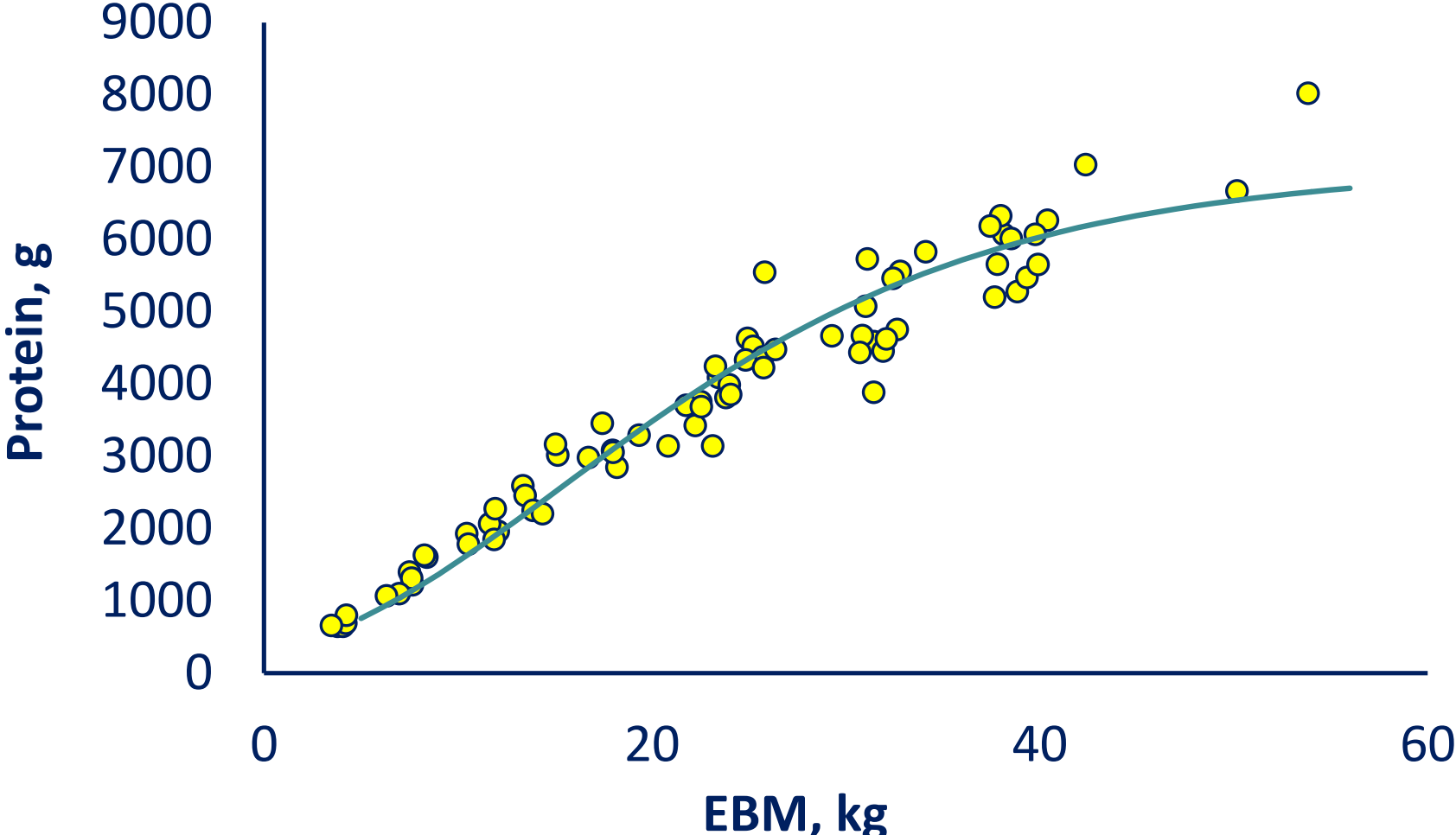
BM = body mass; DMI = dry matter intake; EBM = empty body mass;  
SD = standard deviation, Min. = minimum; Max. = maximum.

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Ash, g

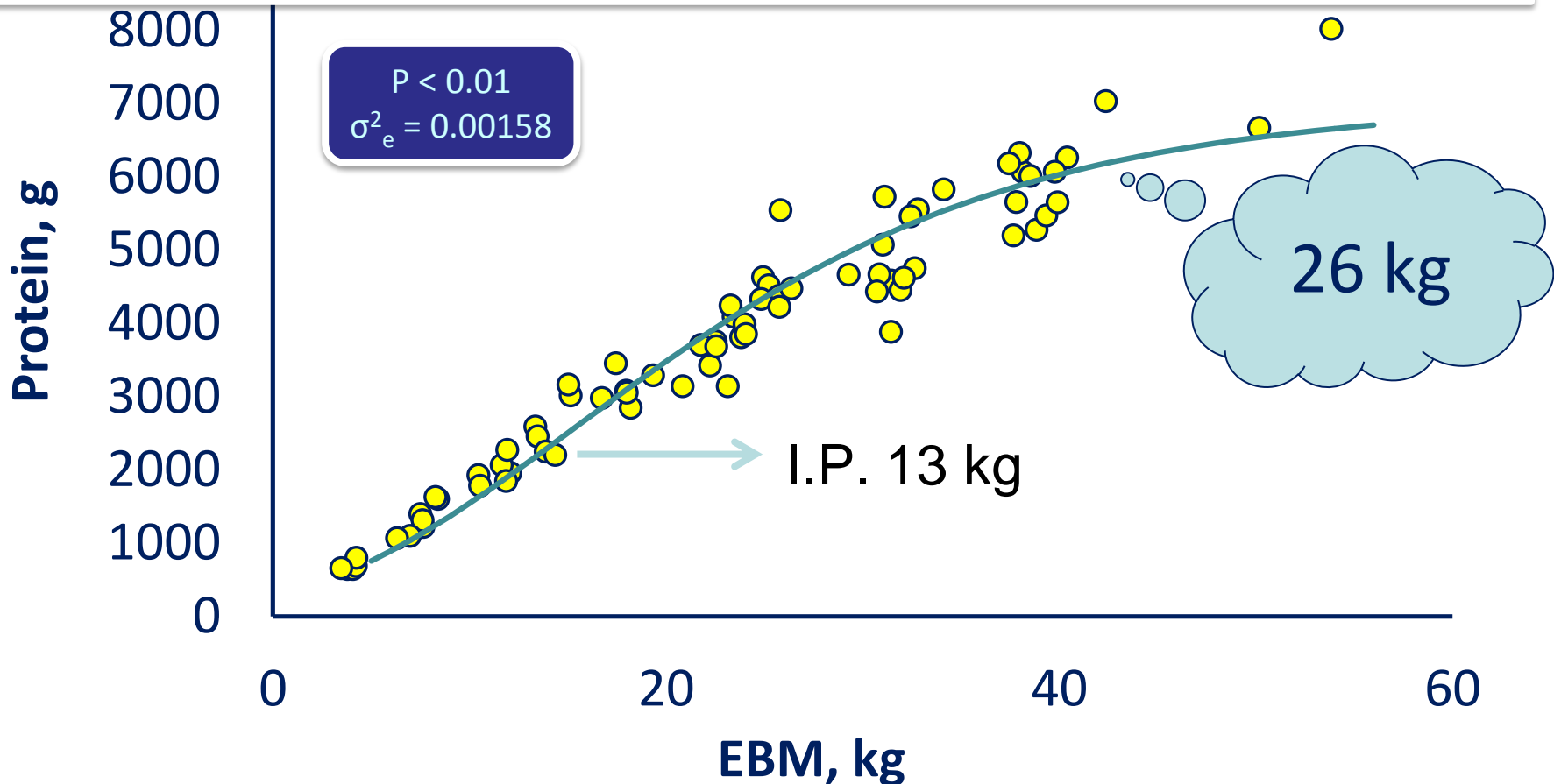


# Results and discussion

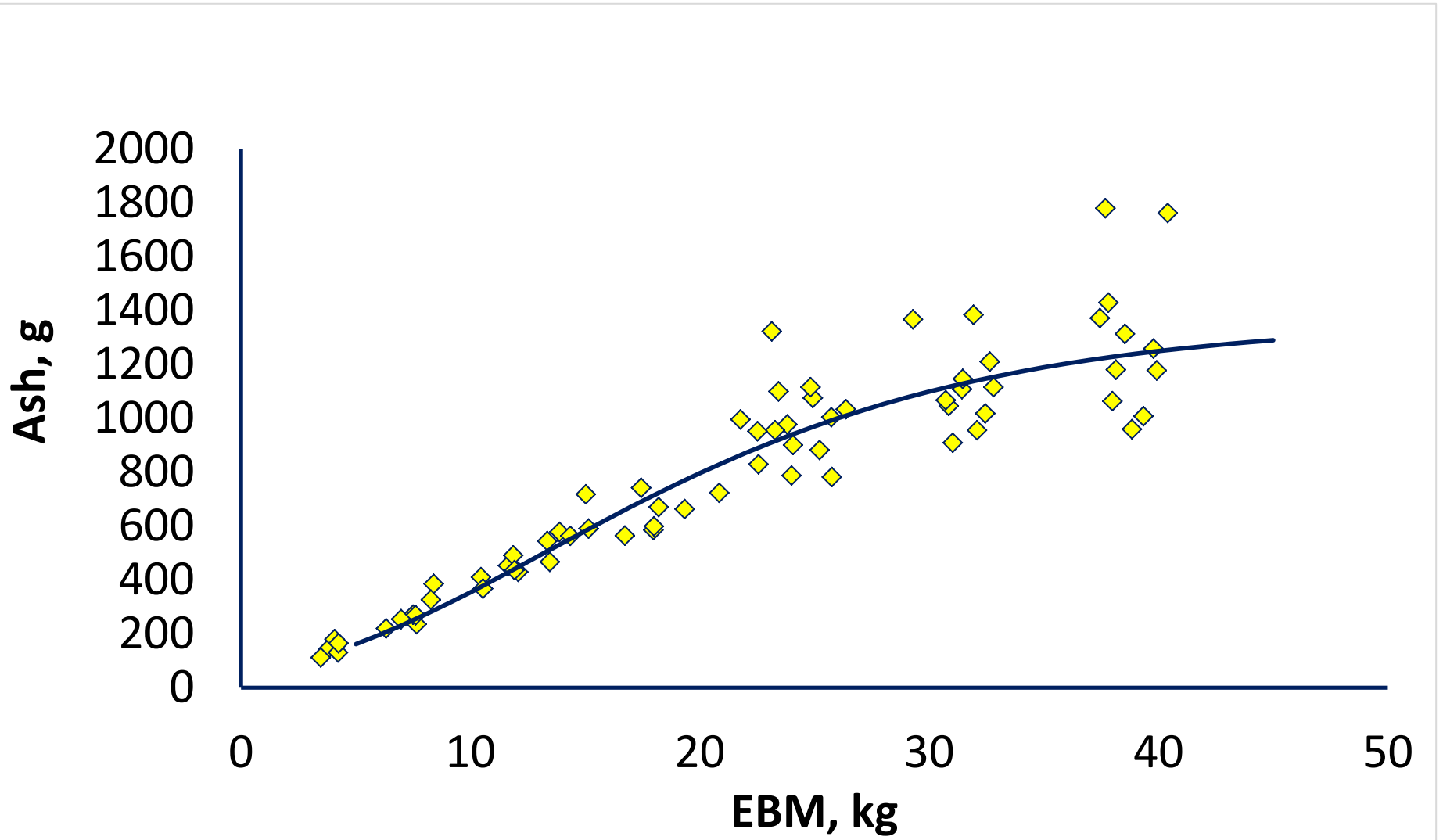


# Results and discussion

$$\text{Protein, g} = 300.1 \pm 24.5 \times \exp^{3.15 \pm 0.0801 \times (1 - \exp^{-0.0772 \pm 0.00480 \times \text{EBM, kg}})}$$



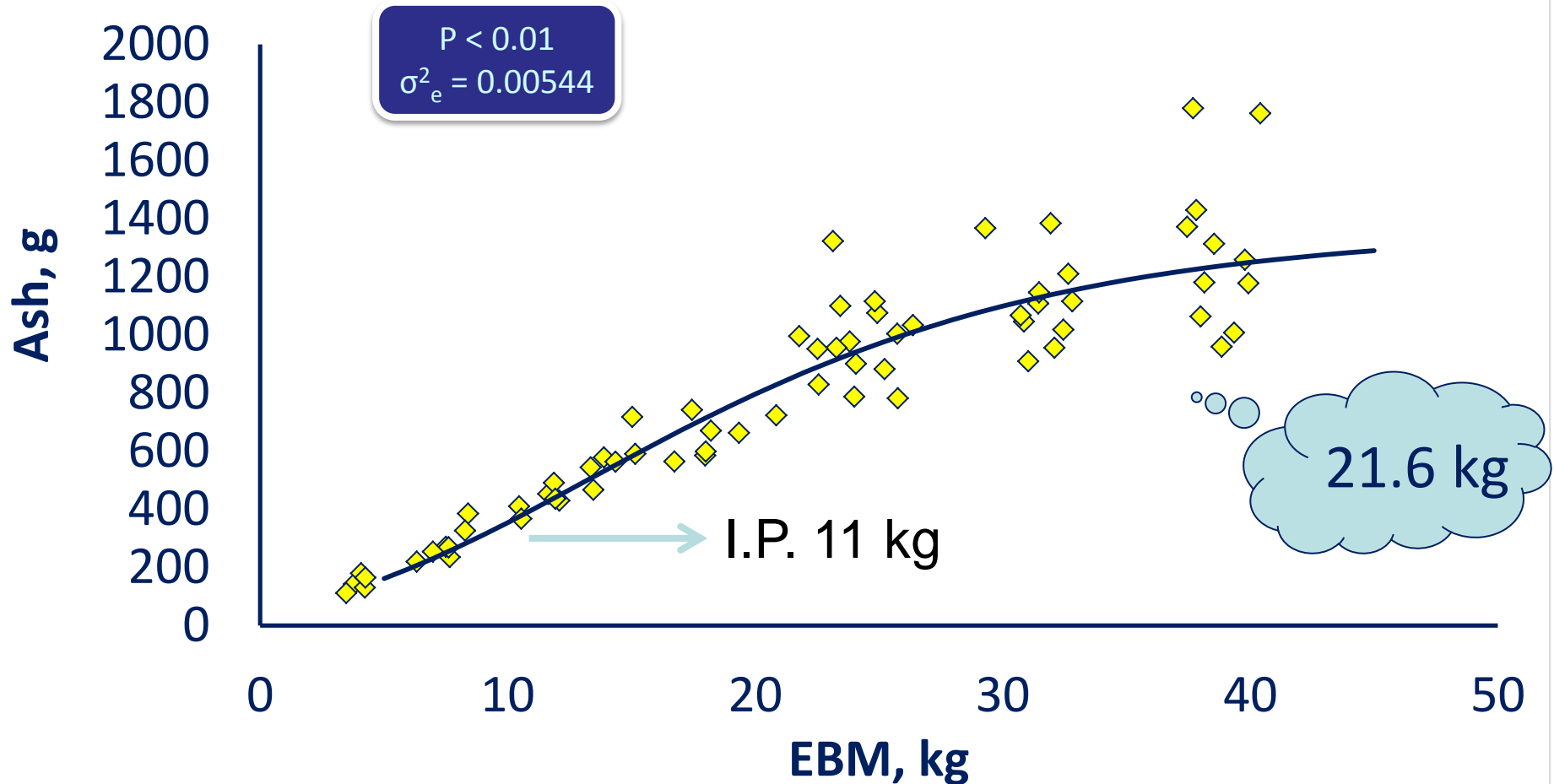
# Results and discussion





# Results and discussion

$$\text{Ash, g} = 53.7 \pm 7.10 \times \exp^{3.232 \pm 0.119 \times (1 - \exp^{-0.0922 \pm 0.00793 \times \text{EBM, kg}})}$$



# Conclusion

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- ✓ Model protein and ash deposition pattern



Equations





# Mature size of Saanen goats

# Background

## MATURITY

Mature weight  
Standard reference  
weight  
Mature size

INRA, (1989); CSIRO,  
2007; NRC, 2000, 2007

Intake, nutritional requirements



# Background

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**MATURITY ?????**

# Background

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**Moulton (1923)** – proposed the concept of **chemical maturity** (when the total protein, water, and mineral contents in the fat-free basis reach a plateau).

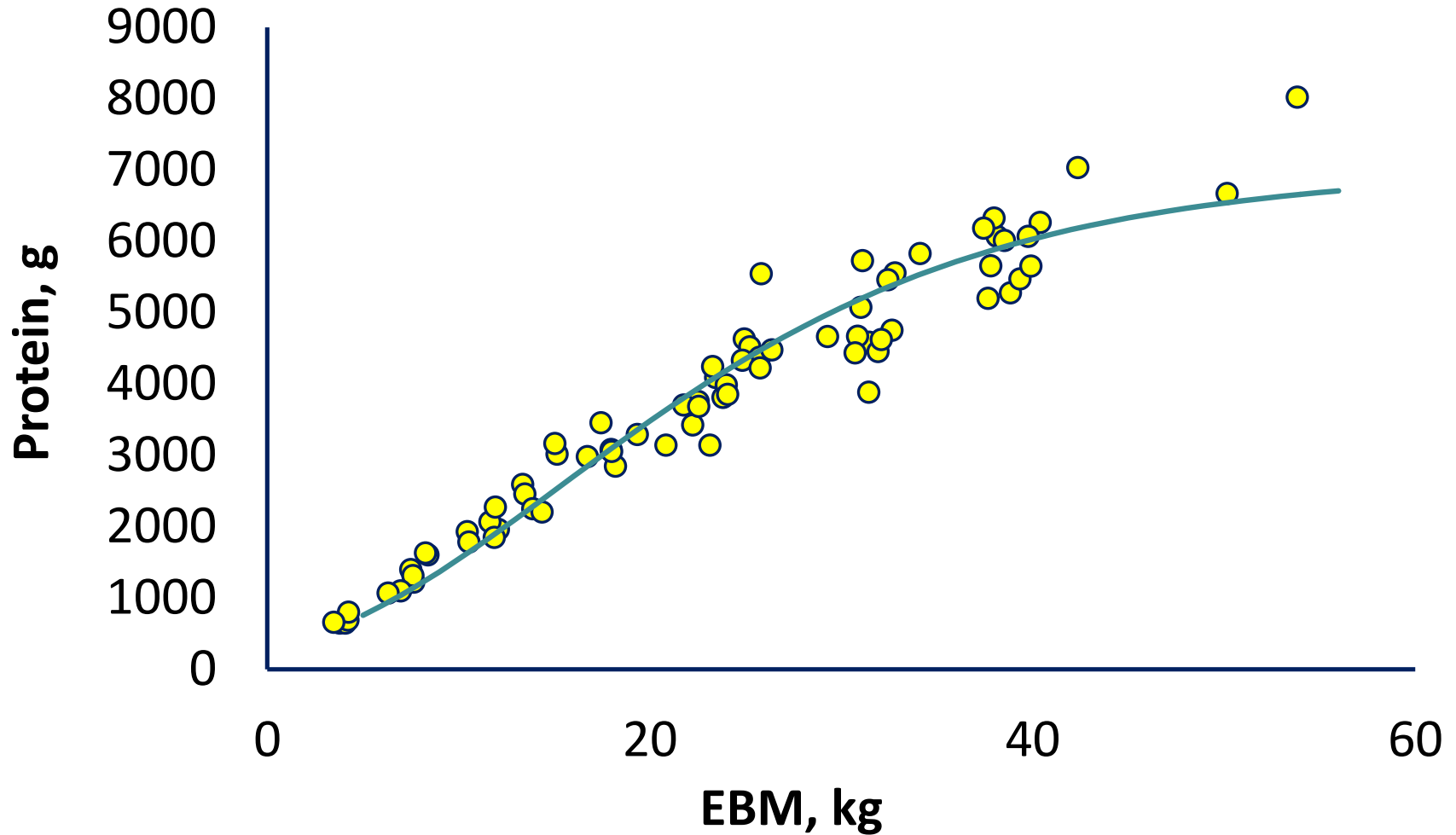
# Background

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**The NRC (2000)** - supported that the chemical maturity may be achieved through the **stabilization of protein accretion** in the empty body.



# Stabilization of protein accretion?



# Background

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**CSIRO (2007)** - considered the achievement of **skeletal development** of a medium BCS animal to define the “standard reference weight”, known as mature weight.

# Background

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Trenkle and Marple (1983), and Tedeschi et al. (2002) - assumed that an animal would reach maturity when the ether extract content of the empty body was around 22%.

**Lack of definition of appropriate estimators (i.e., protein, ash, water, or fat) of mature weight.**

# Objective

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Meta-analysis → to provide approaches to estimate maturity of female Saanen goats (body composition)



## Database (5 studies)

***Individual records:*** 76 female Saanen goats

Diet: dehydrated corn plant or Tifton hay, ground corn, soybean meal, soybean oil, limestone, mineral supplement and ammonium chloride

**16.6 ± 1.9% of CP and 4,172.5 ± 278 kcal/kg of GE (DM basis).**

# Statistical analysis

Selection of candidate equations

**Preliminary graphical examination**

Logistic function:  $Y = \beta_0 \times \exp^{(-\beta_1 \times \text{EBM}) + \beta_2}$

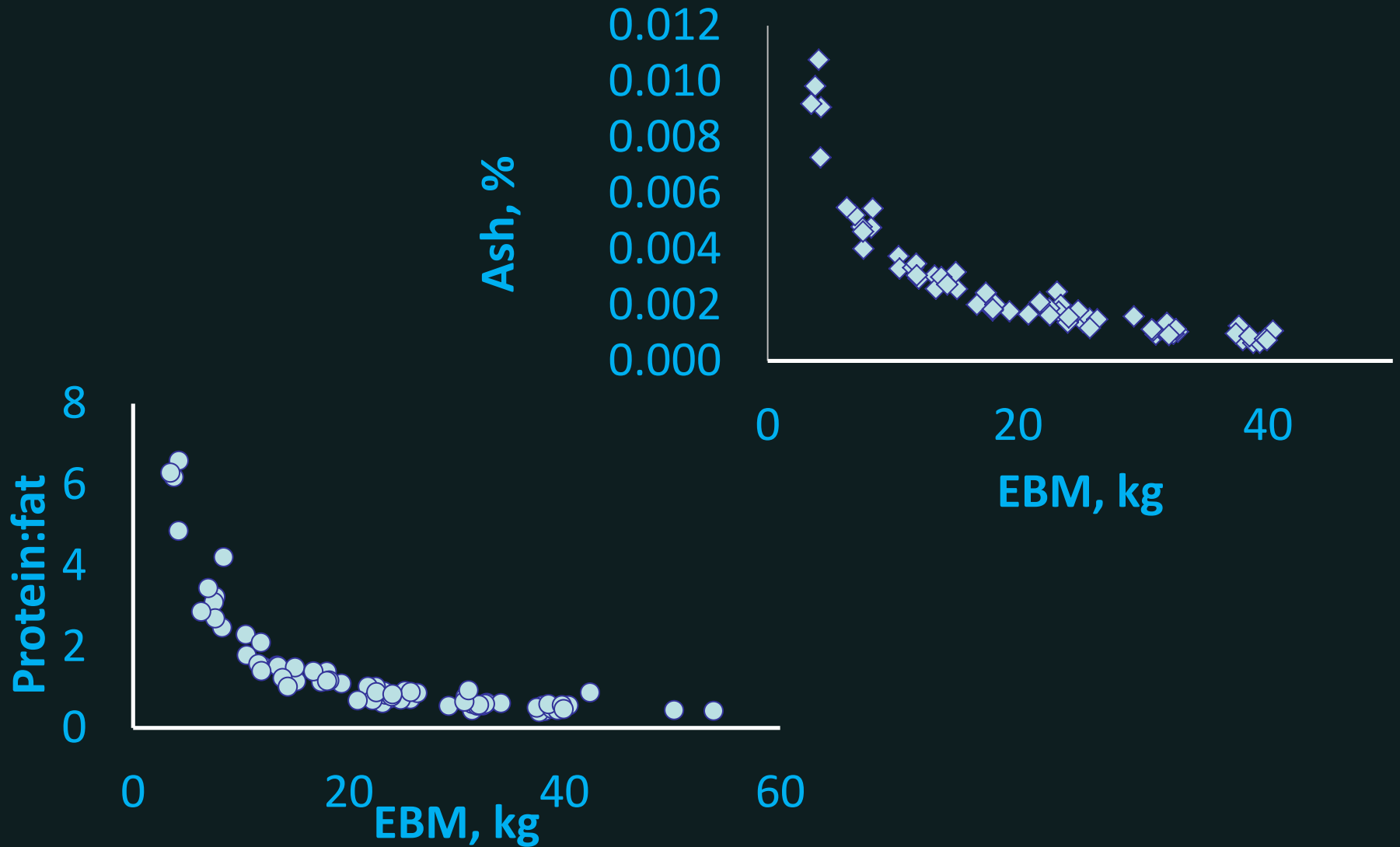
Where  $\beta_2$  is the asymptotic of ash or protein:fat ratio

Fitted using a **nonlinear mixed model** methodology (SAS macro %NLINMIX; SAS Inst. Inc., Cary, NC; v. 9.4).

Between-study variability

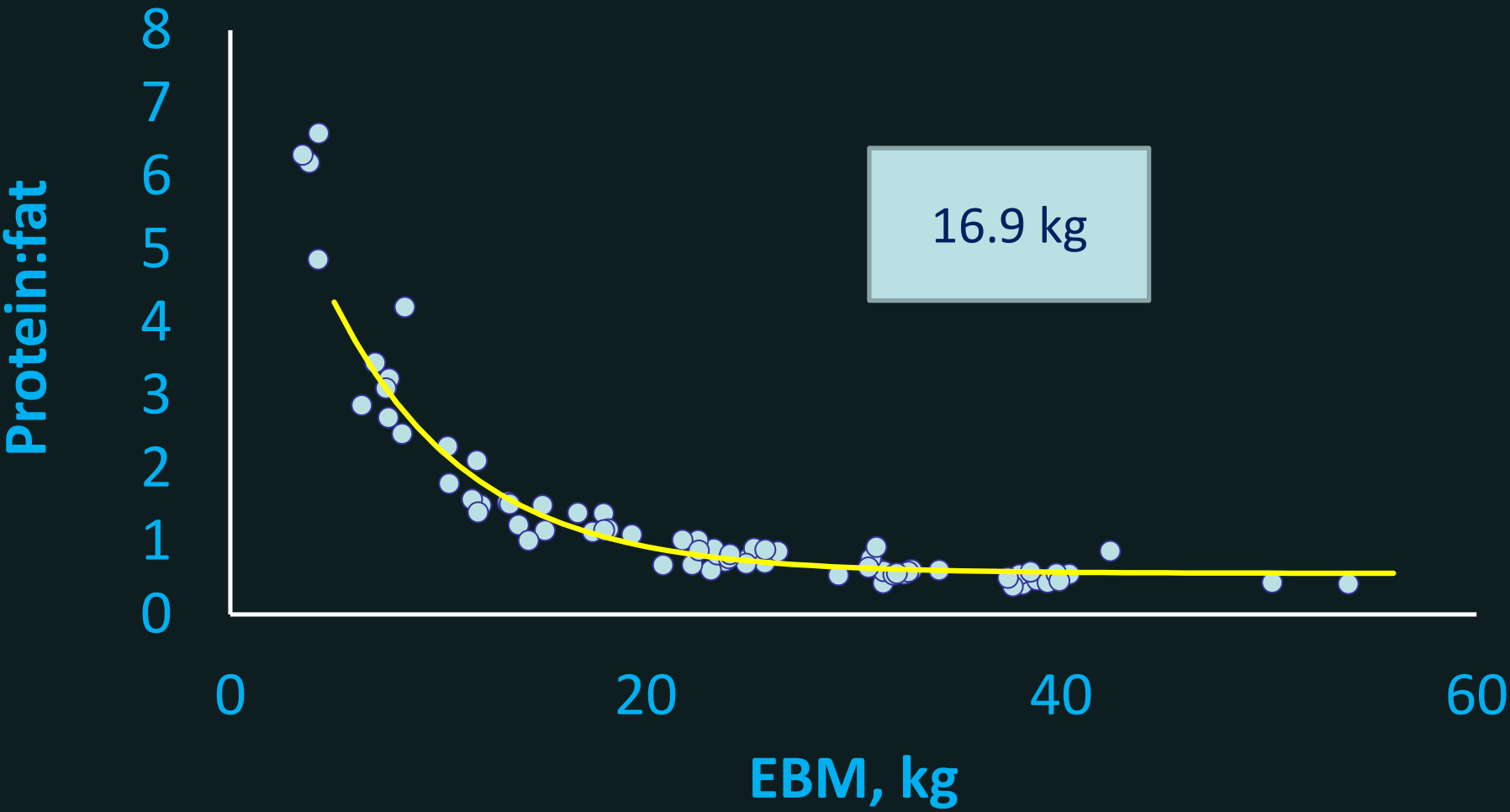
$u_1$ ,  $u_2$  and  $u_3$  to the  $\beta_0$ ,  $\beta_1$  and  $\beta_2$  parameters.

# Results and discussion

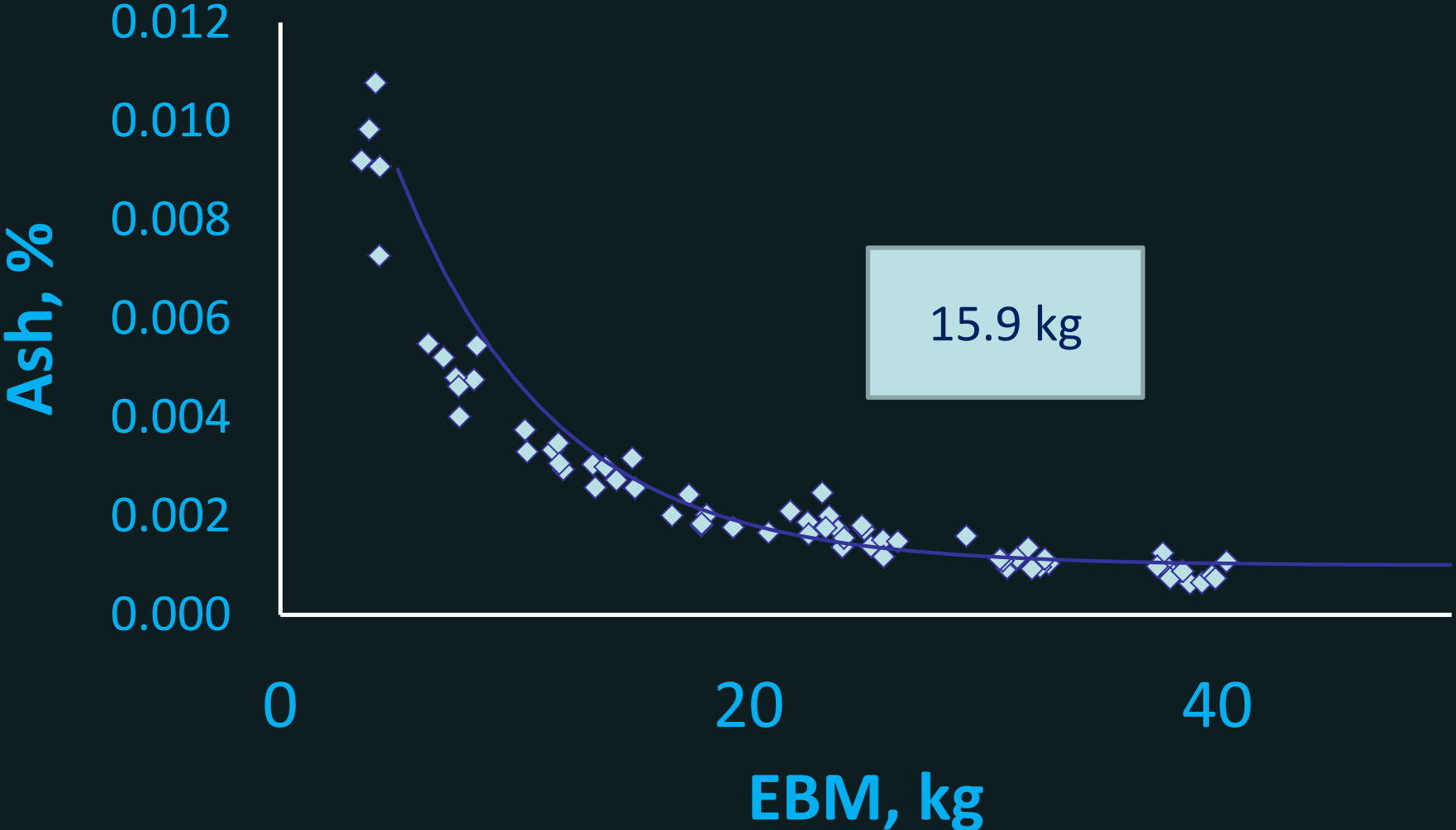




# Results and discussion



# Results and discussion



## A bit more...

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$$y = \beta_0 \times (1 + \exp(\beta_1 \times EBM)) + e$$

Where  $y$  is empty body **protein** percentage in the water-free EBM;  $\beta_0$  and  $\beta_1$  are the parameter estimates and  $e$  is the residual.

# A bit more...

$$\text{EBP, \%} = 36.7 \pm 2.51 \times (1 + \exp^{-0.0747 \pm 0.023 \times \text{EBM}})$$

**Plateau – 27 kg EBM = 22.8 % of EBF**

Trenkle and Marple (1983), and Tedeschi et al. (2002)

# Final remarks

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The identification of **mature size** is an important step to adequately formulate diets.

**Standardize** the method of estimation.

Effect of breed, sex and nutrition...

# Acknowledgments

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**Thank you.**

**Co-workers** 



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