Protein Deposition of Modern Broilers.



MASSEY UNIVERSITY

Patrick Morel

Animal Nutrition Division

Institute of Veterinary, Animal & Biomedical Sciences

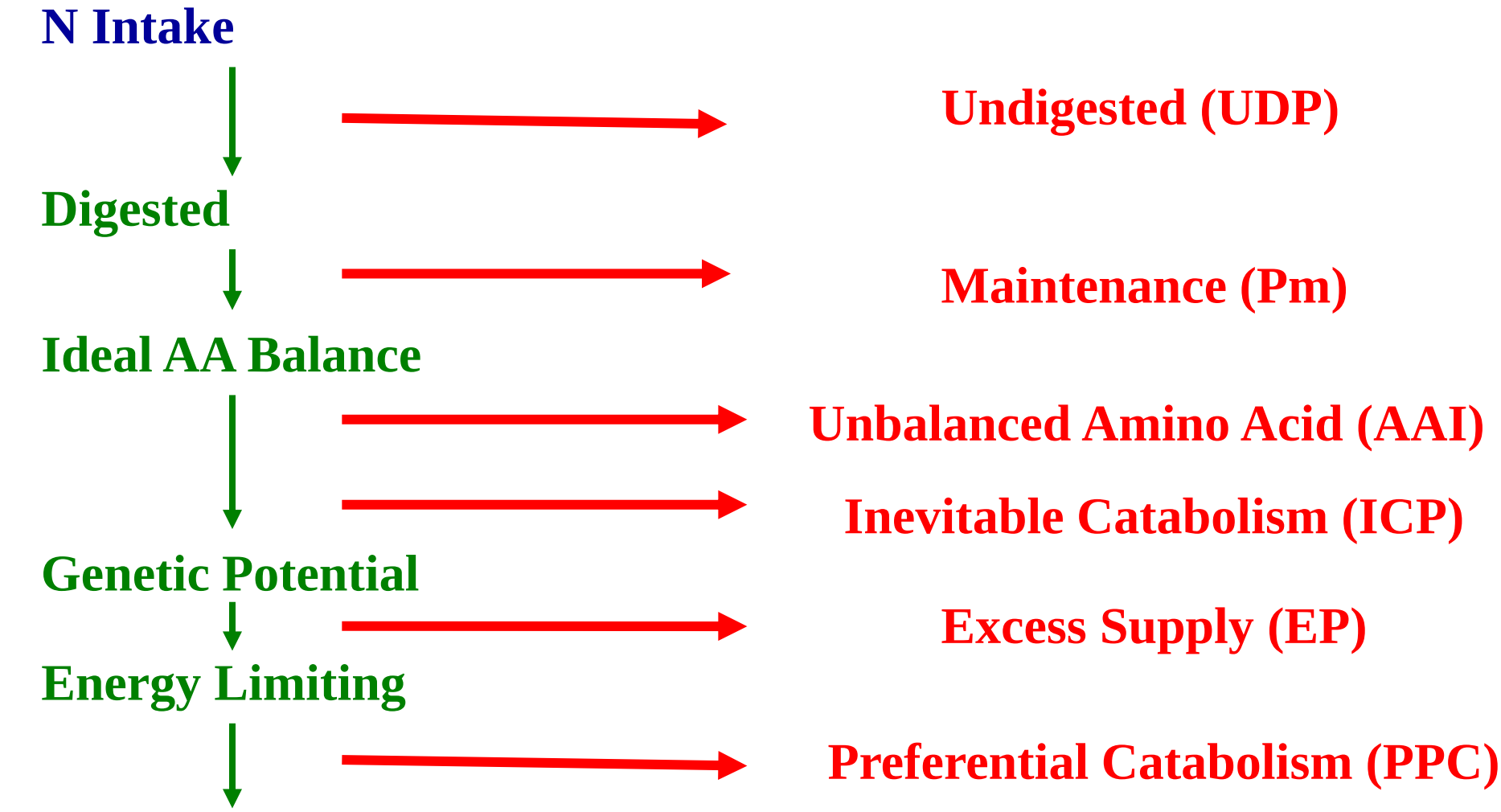
p.c.morel@massey.ac.nz

Introduction

- Knowledge on the potential for protein deposition of modern broiler is essential for establishing their protein (amino acids) and energy requirements and to be able to formulate diet which maximize profitability.

Nitrogen partitioning in pig with different protein deposition potential

(Morel & Wood, 2005)

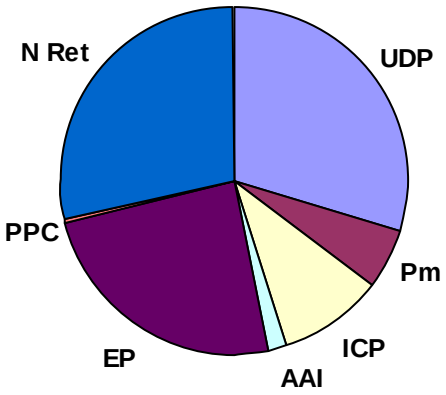


Nitrogen partitioning in pig with different protein deposition potential

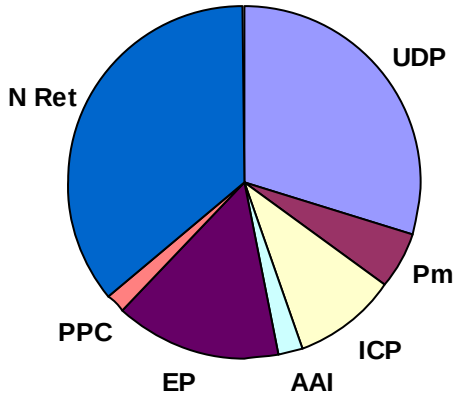
(Morel & Wood, 2005)

Practical

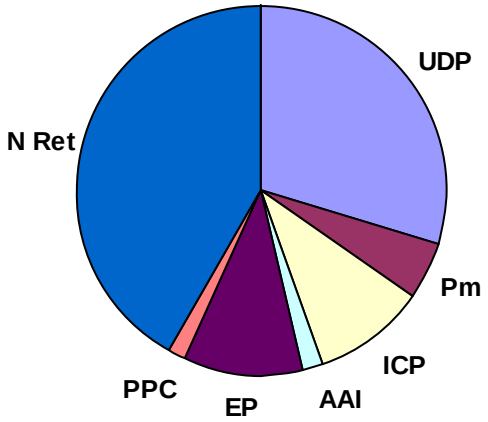
120 g/d



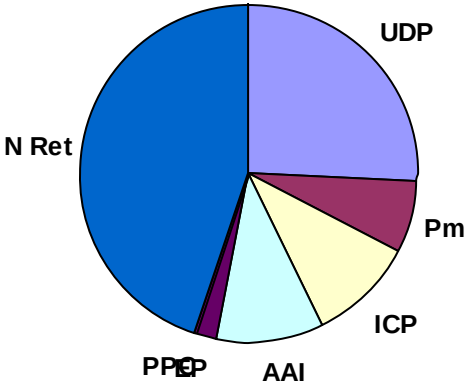
160 g/d

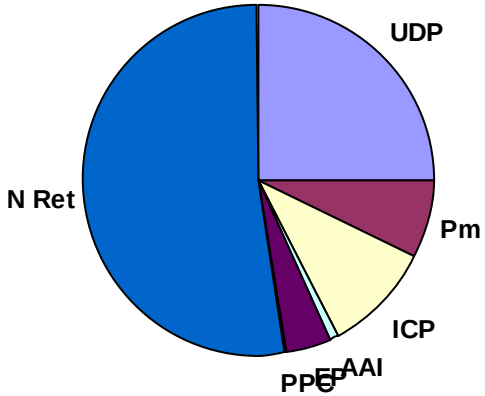


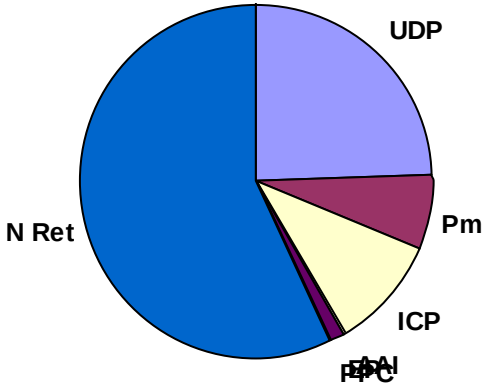
200 g/d



Optimized







Nitrogen (Protein) Flow in Growing Pigs

N Intake

Undigested: 23-26 % => digestibility / cost ? additives?

Digested

Maintenance: 5-8% => fixed (faster growth)

Ideal AA Balance

Unbalanced Amino Acid: 4-12 % => formulation

Inevitable Catabolism: 10% => fixed (new genotype?)

Genetic Potential

Excess Supply: 2-18 % => match supply to genotype

Energy Limiting

Preferential Catabolism: 0-1% => not a problem

Protein Deposition **32-52% => used better genotype**

Introduction

- Over the years the live weight growth patterns of broiler chicken have dramatically changed.

- What did happened in term of body composition?

Describing Animal Growth

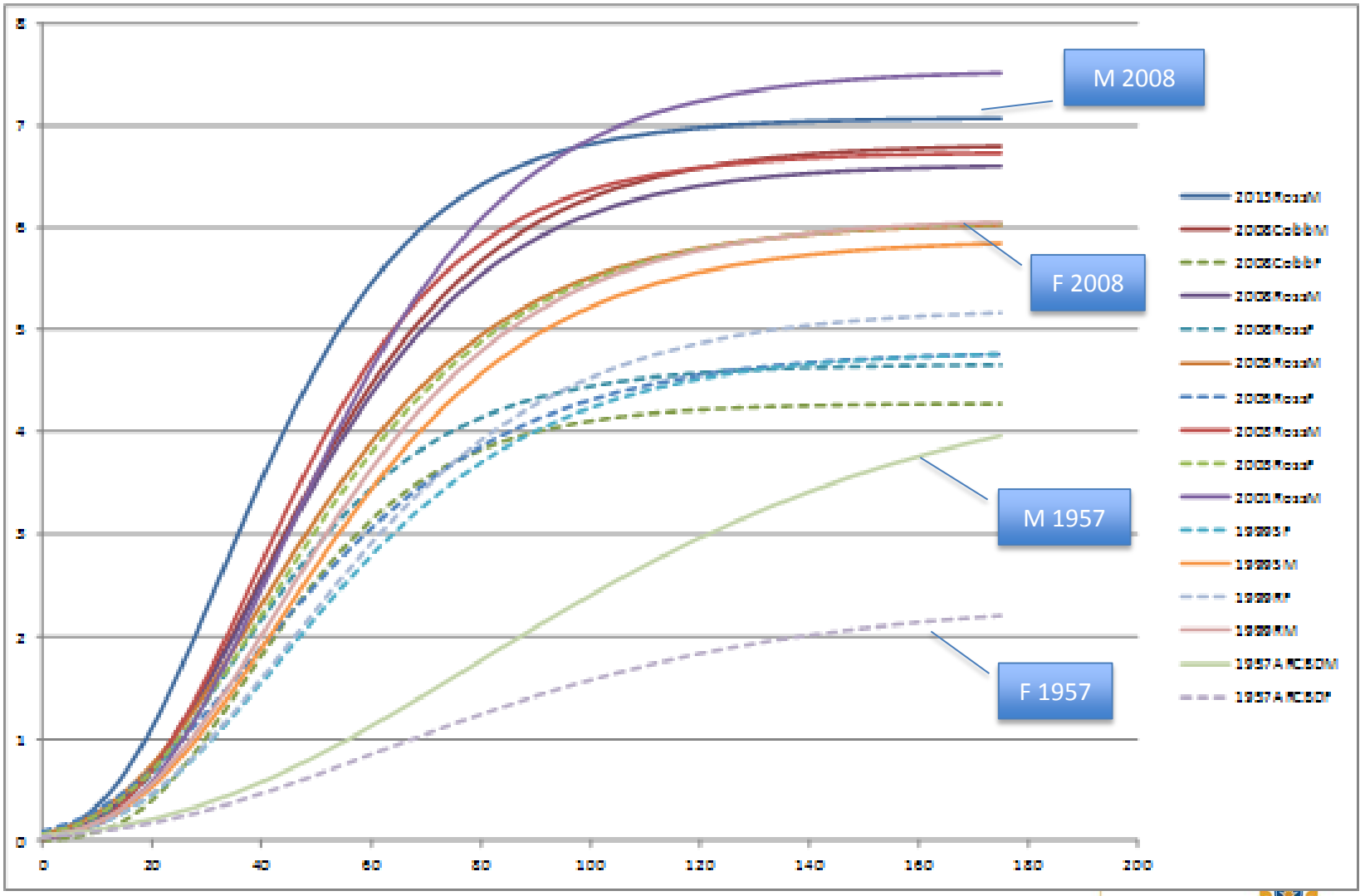
Gompertz equations are often use.

$$W_t = W_m \times e^{-e(-B(t-t^*))}$$

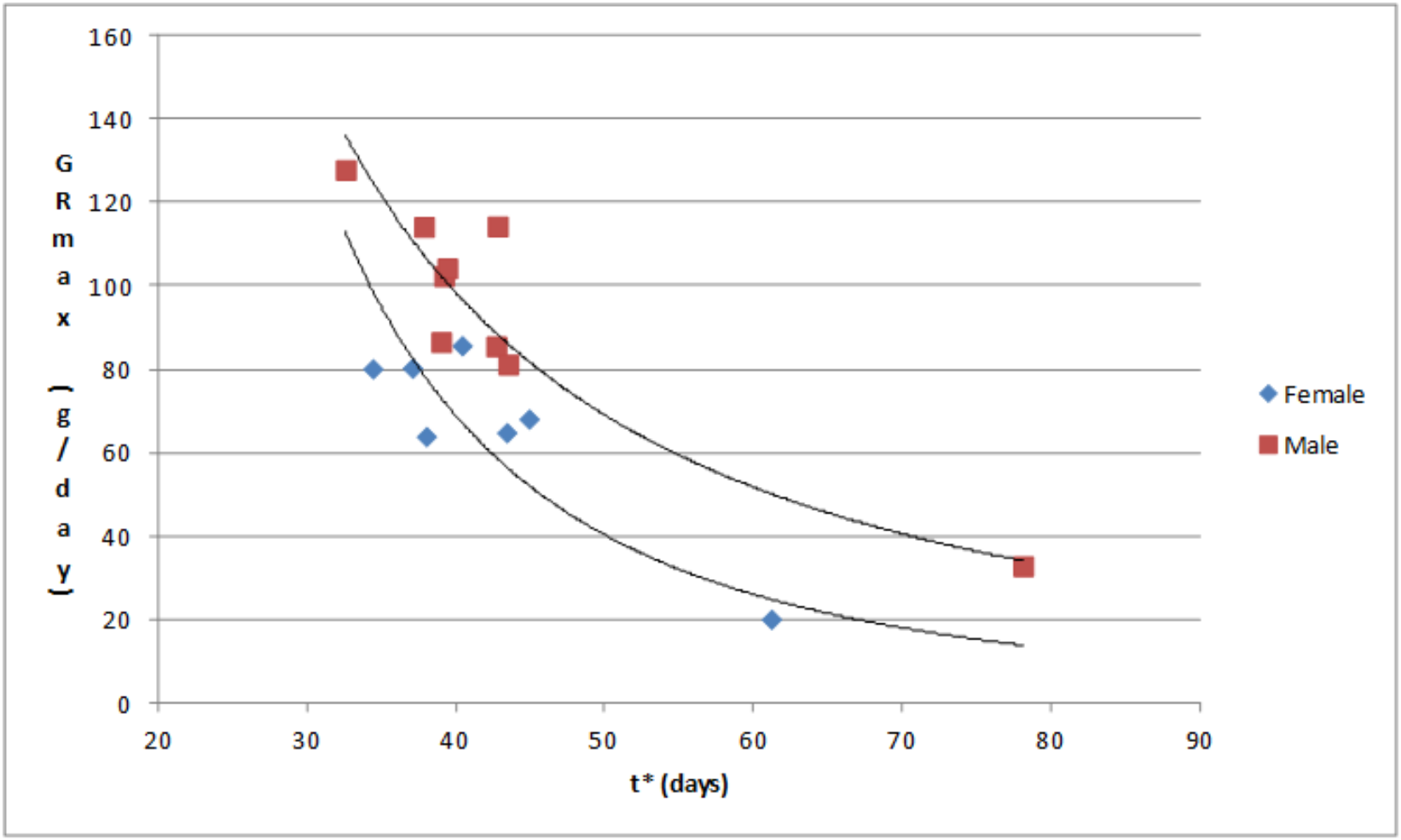
- with W_t= mass at age t; W_m= mass at maturity; B = rate of maturity, t^* age at maximum rate of maturity).

- The maximum growth rate (GR_{max}) or protein deposition rate (PD_{max}) is then achieved at the inflexion point (t*).

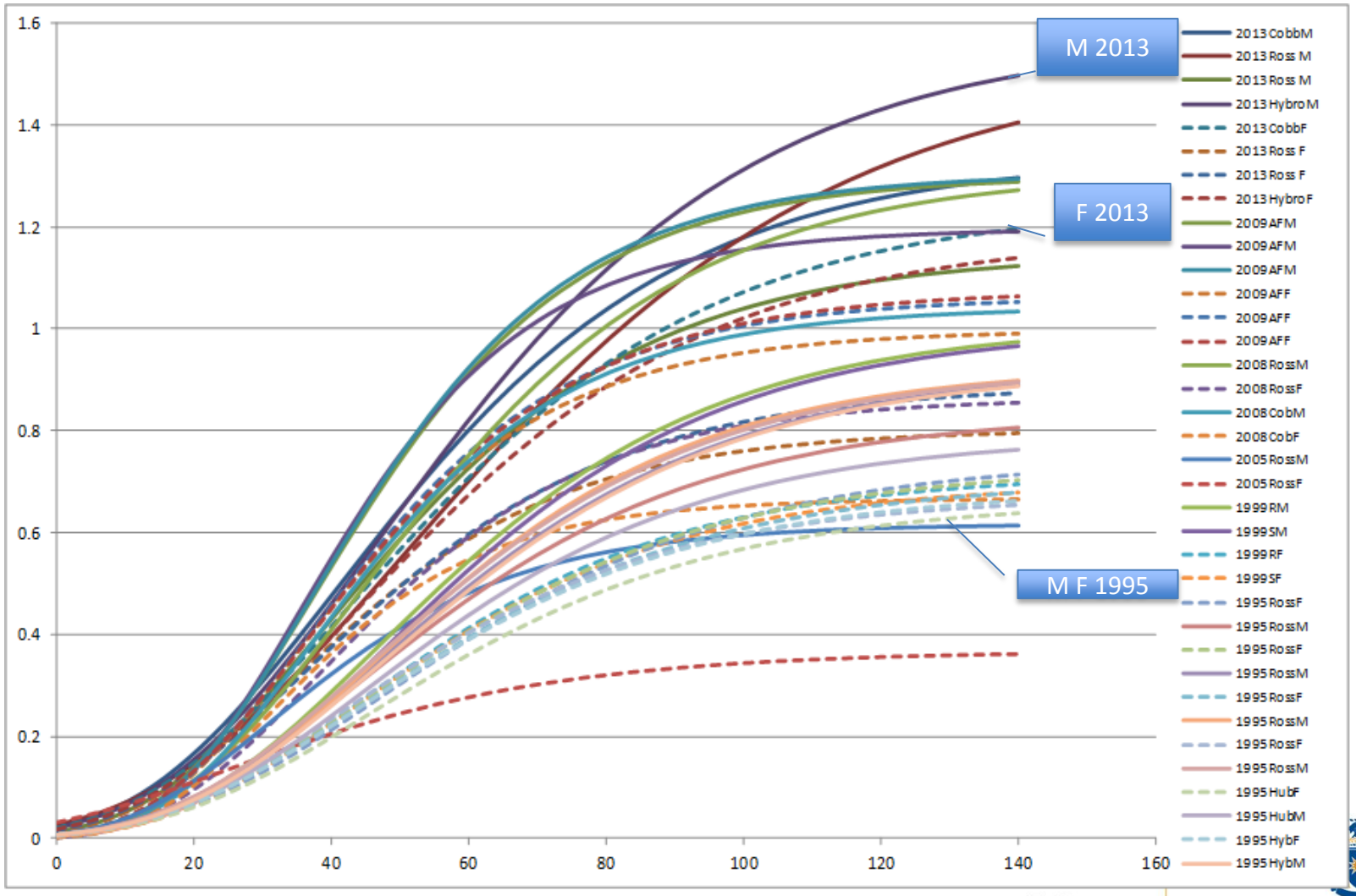
Overview of live weight growth patterns for male and female broiler chicken between 1957 and 2013.



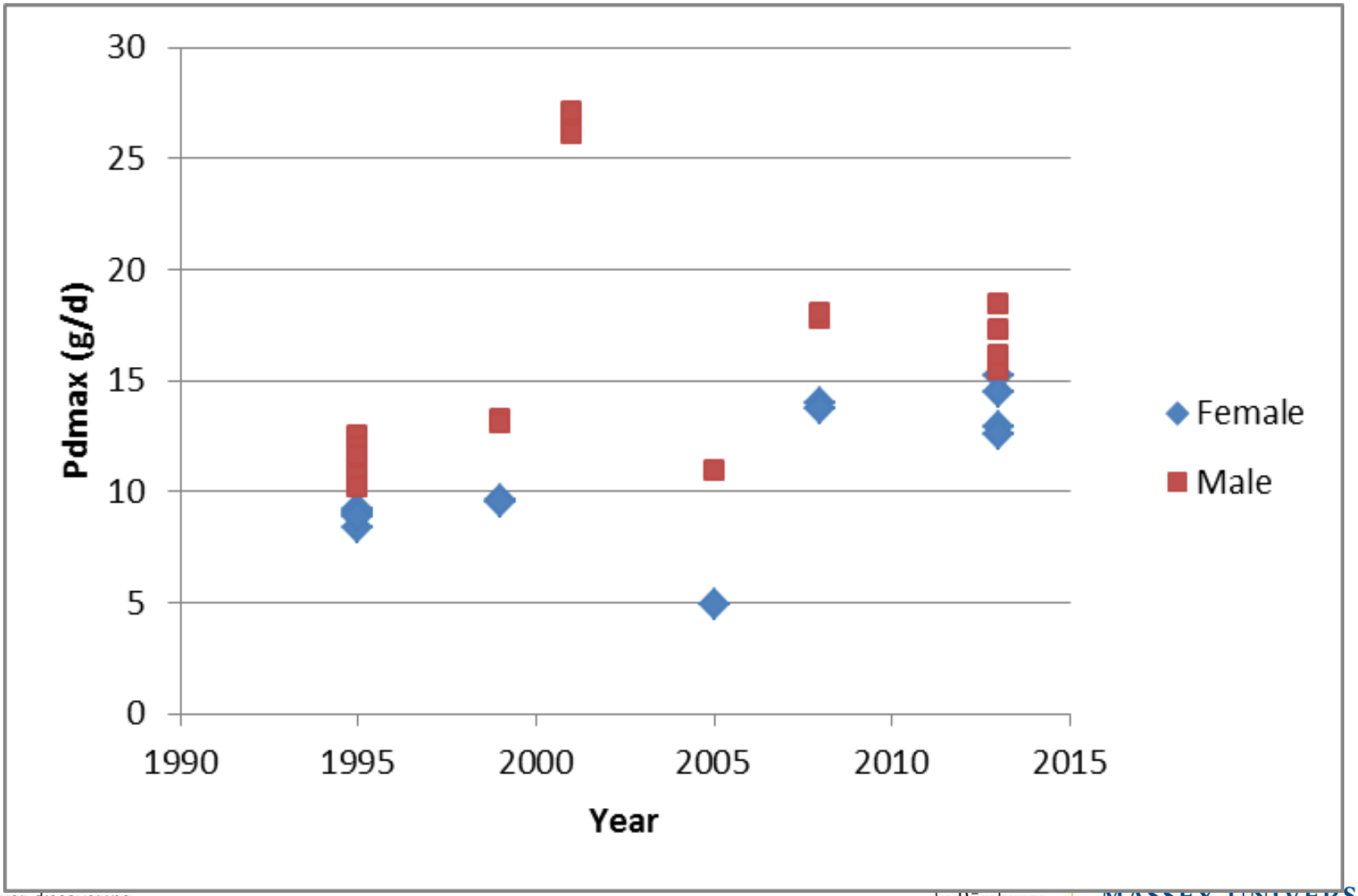
Relationship between age at maximum growth rate (t*) and maximum growth rate (GR_{max})



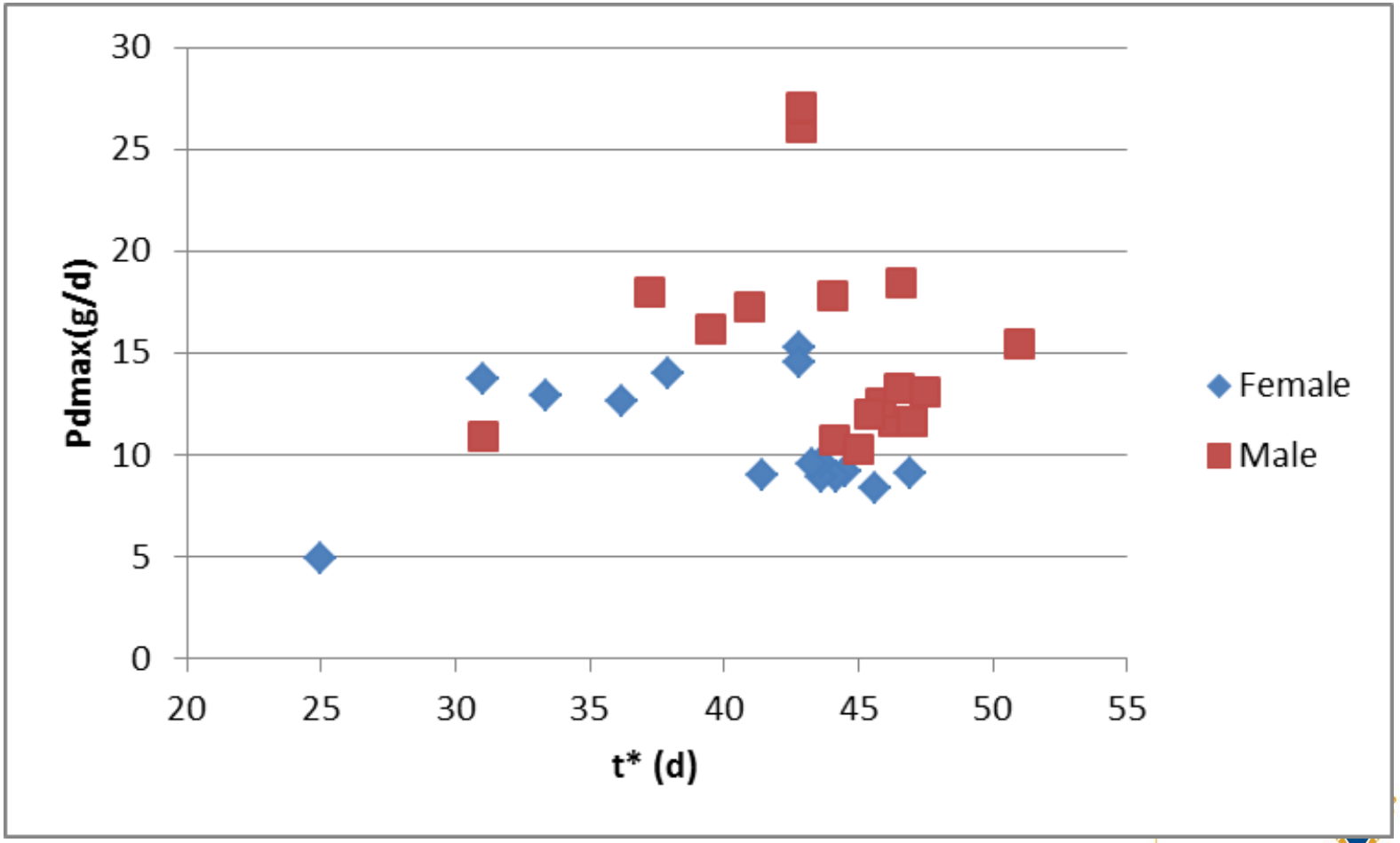
Overview of body protein growth patterns for male and female broiler chicken between 1995 and 2013.



Change in Pdmax overtime



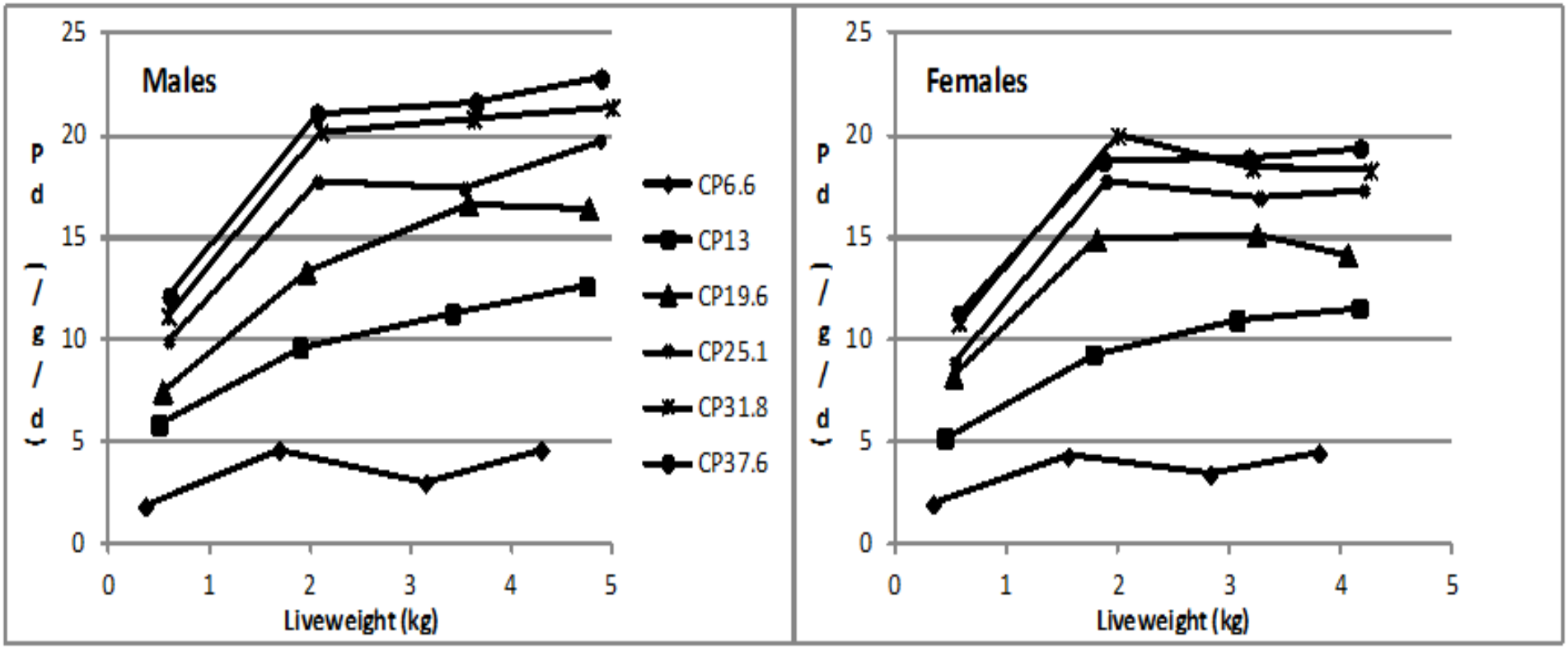
Relationship between age at maximum protein deposition (t*) and maximum protein deposition (Pd_{max})



Diet and Pdmax

When measuring Pdmax it is important that the dietary contents in protein (amino acids) and energy are not limiting protein deposition

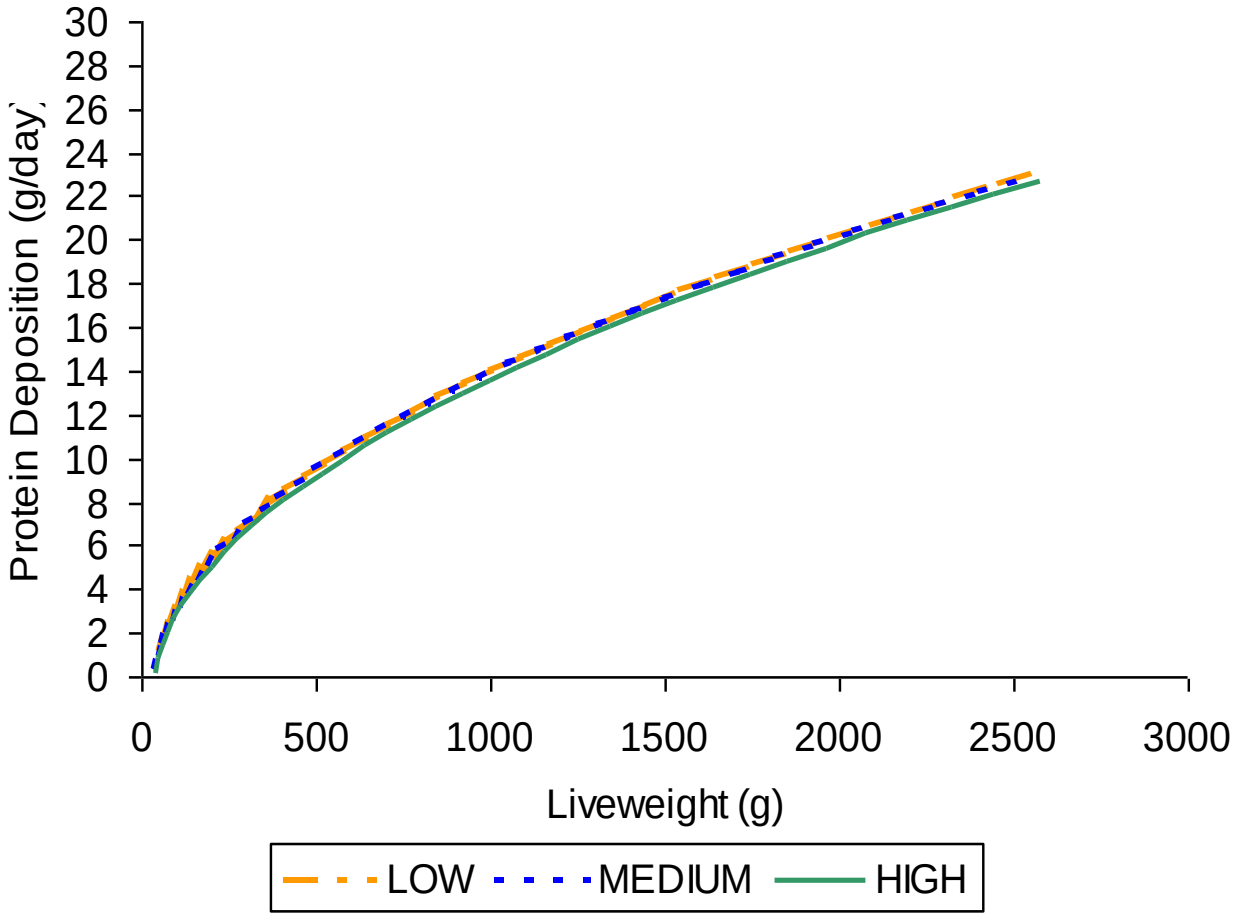
Effect of dietary protein levels on protein deposition rate for male and female broiler chickens fed high energy diet (AME > 14.5 MJ, Samadi and Libert; 2006).



Effect of live weight and dietary energy content on body protein deposition (>25 % crude protein, Morel et al. 2002).

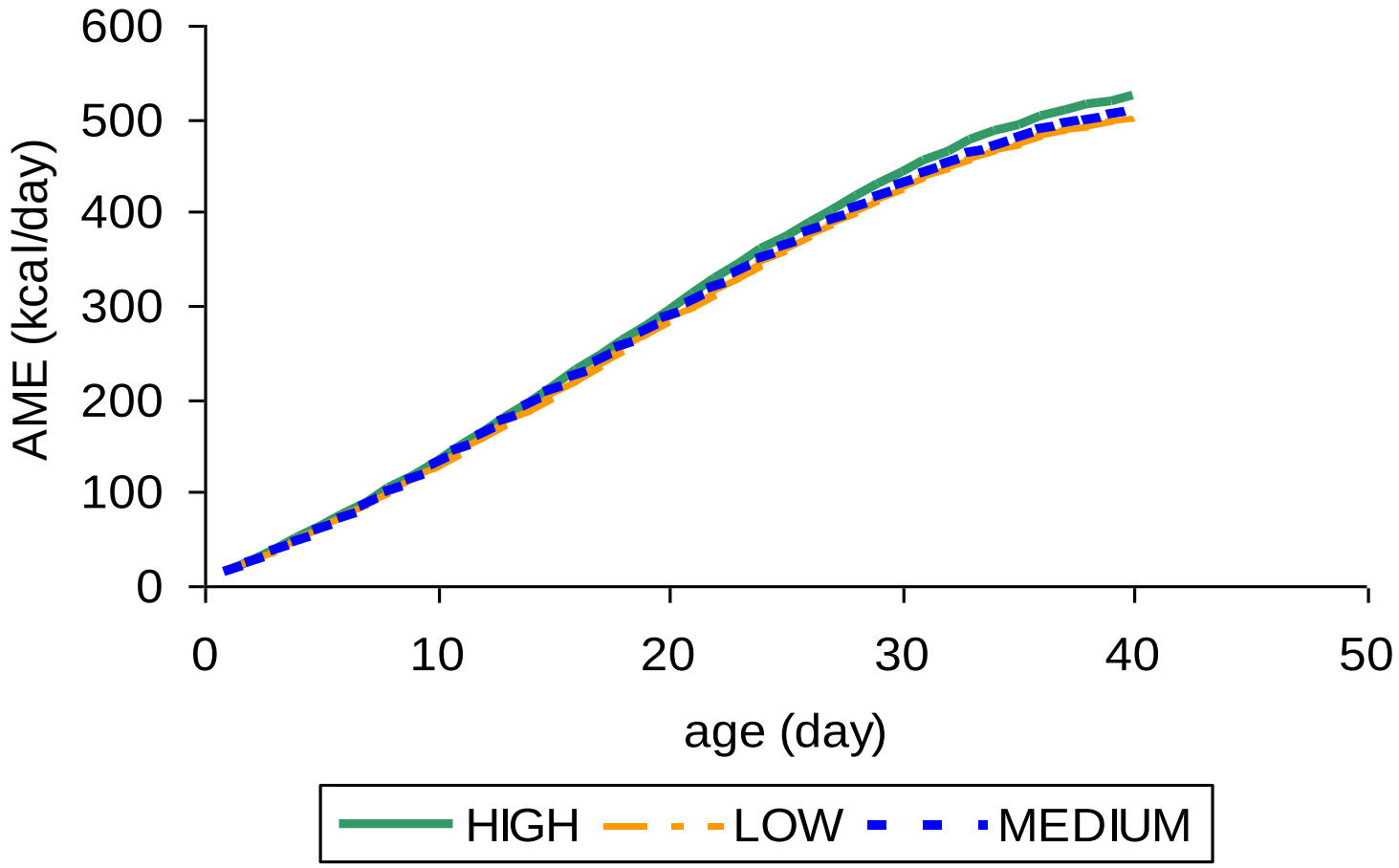
as fed	Low	Medium	High
Crude Protein (%)	27.64	26.58	25.26
Crude Fat (%)	2.65	4.10	8.89
Lysine (%)	1.7	1.61	1.53
Meth+Cys (%)	1.15	1.21	1.27
AME (kcal/kg)	2736[a]	3174[b]	3480[c]
Ileal Protein (%)	23.77	22.86	21.73

Daily Protein Deposition



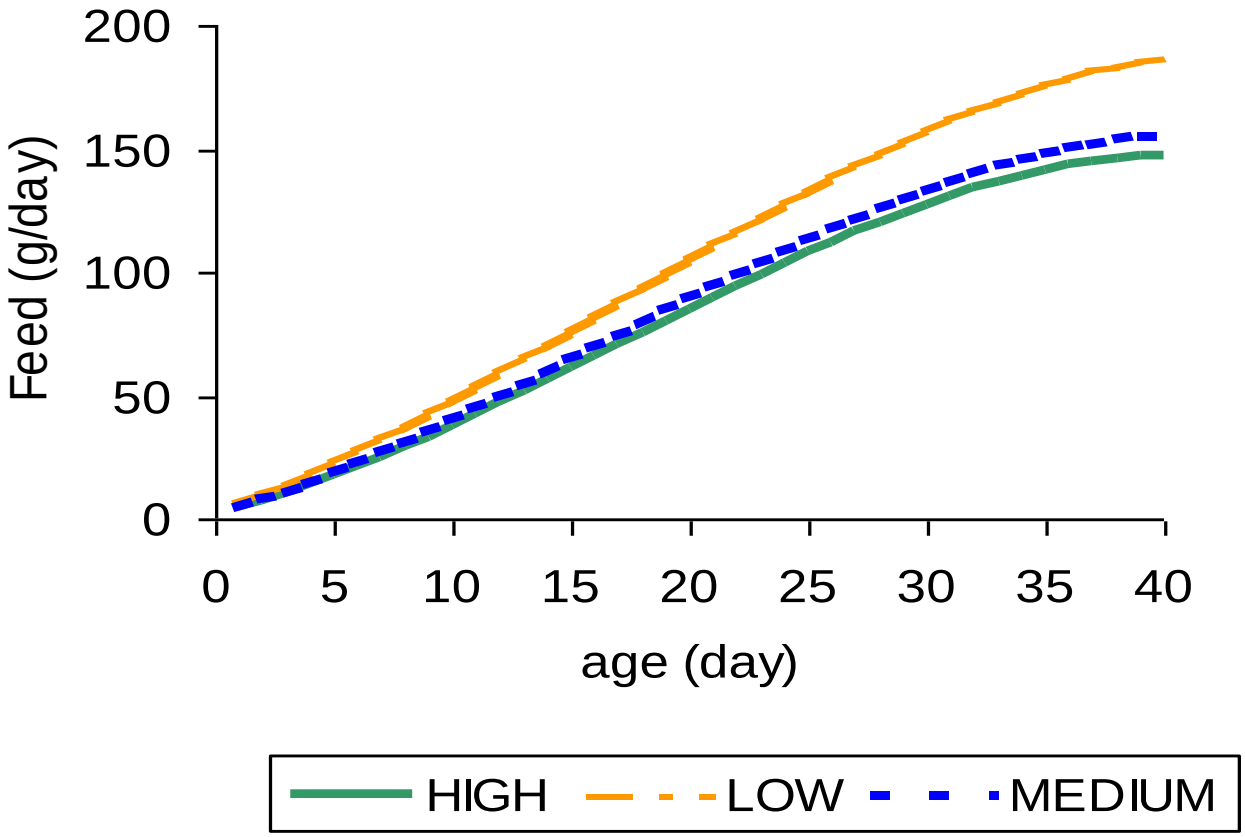
LOW = MEDIUM = HIGH (P>0.05)

AME INTAKE



LOW = MEDIUM < HIGH (P<0.05)

FEED INTAKE

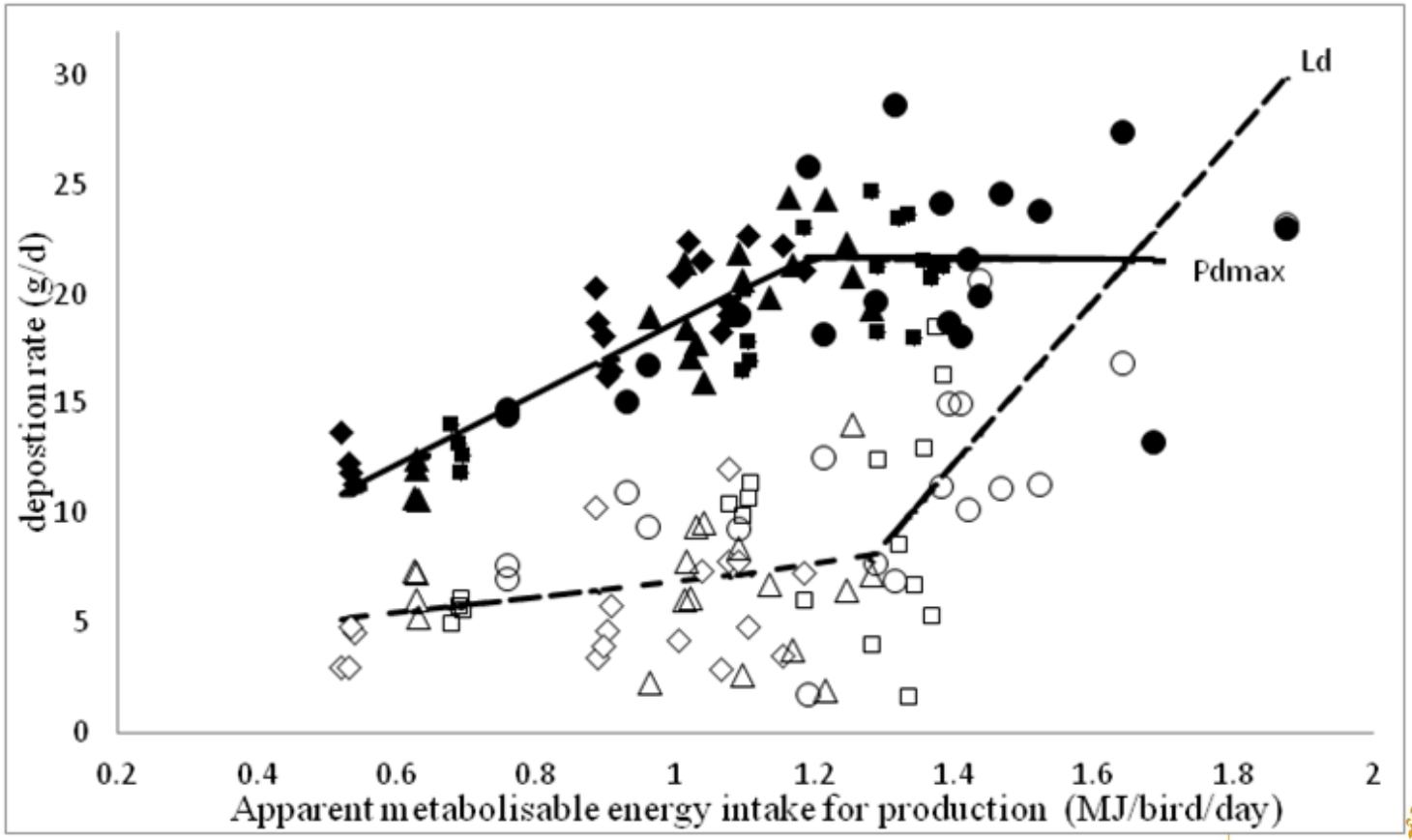


LOW > MEDIUM > HIGH (P<0.05)

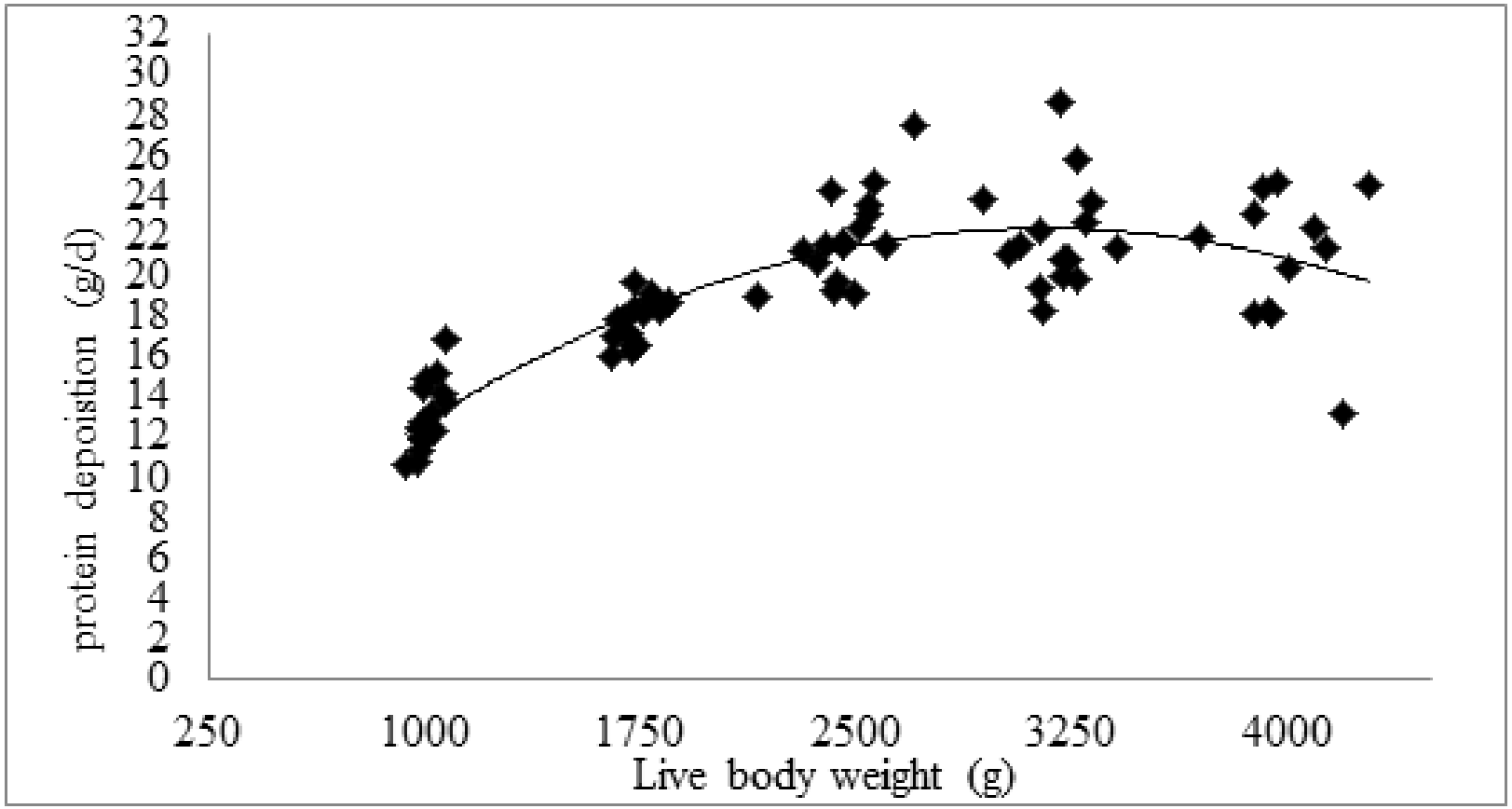
Relationship between the apparent metabolisable energy intake over maintenance and body protein and lipid deposition rate

(high protein diets (>25.9 %), ♦ L-Energy, ▲ M-Energy, ■ MH-Energy, ● H-Energy

Shatnawi, 2013)



The relationship between the live body weight (g) and the body protein deposition (g/d) (Shatnawi, 2013)

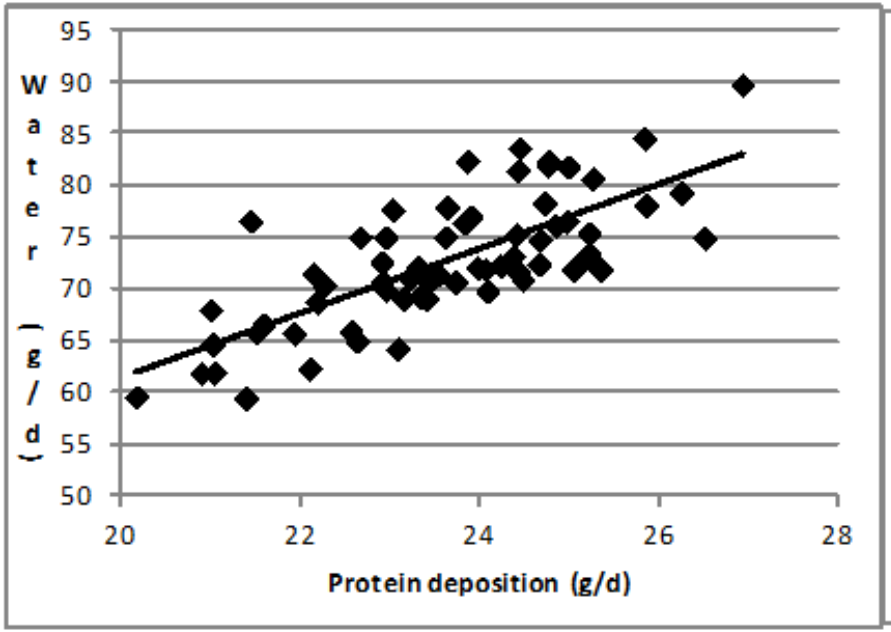


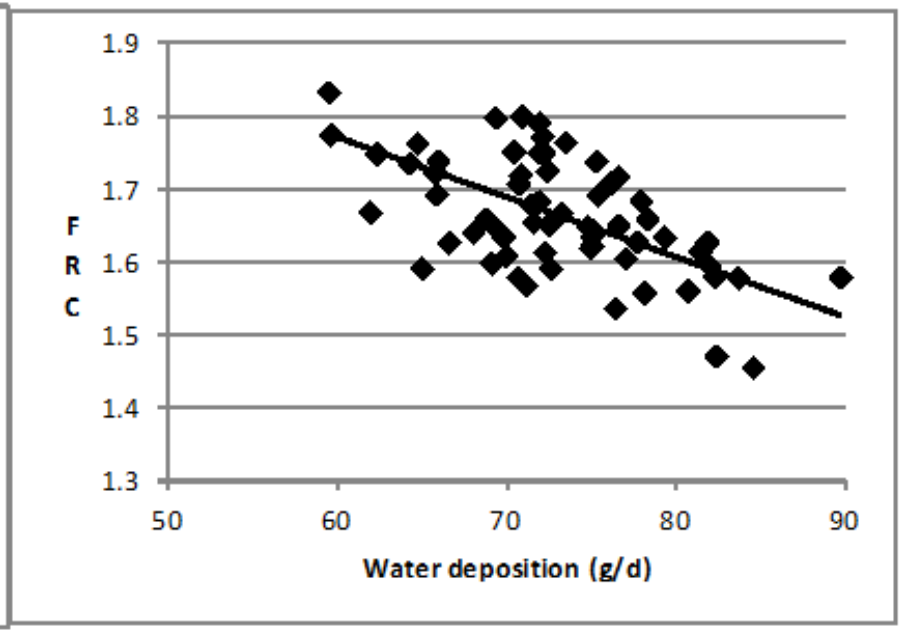
Protein deposition and other traits

- Modern genotype selected for fast growth, better FCR, higher breast yield ….

- Body protein are mainly deposited in muscle, muscle have a high content of water , thus energy used for depositing protein instead of lipid leads to greater growth rate.

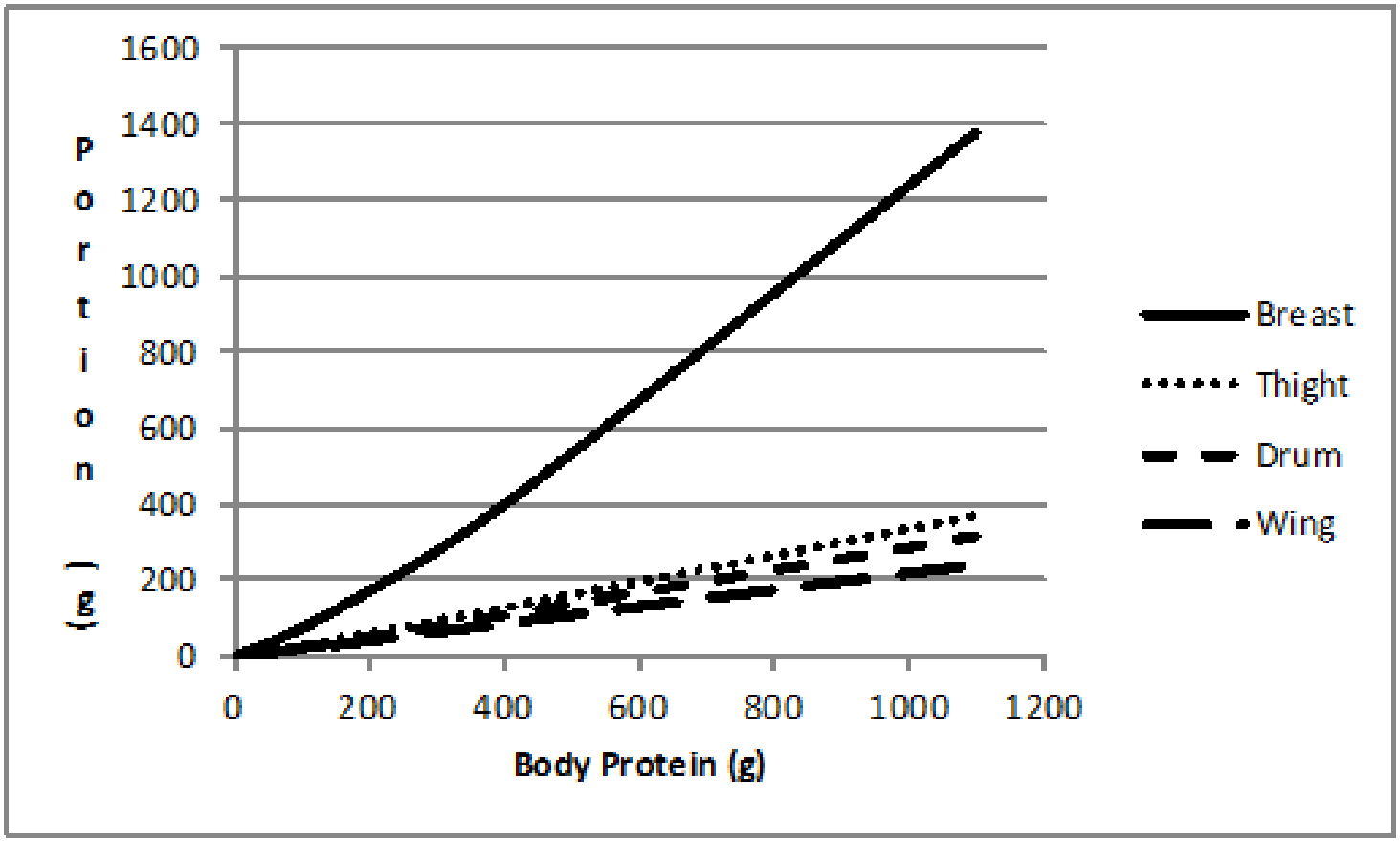
Relationship between protein deposition rate and water deposition rate (a) as well as the relationship between water deposition and FCR (b) between day 21 and 42 in male broiler chicken (Morel, 2013)





Higher protein deposition => higher water deposition
=> Better FCR

Relationships between the body protein content, and the mass of breast, thigh, drum and wing (Danisman and Gous, 2011)

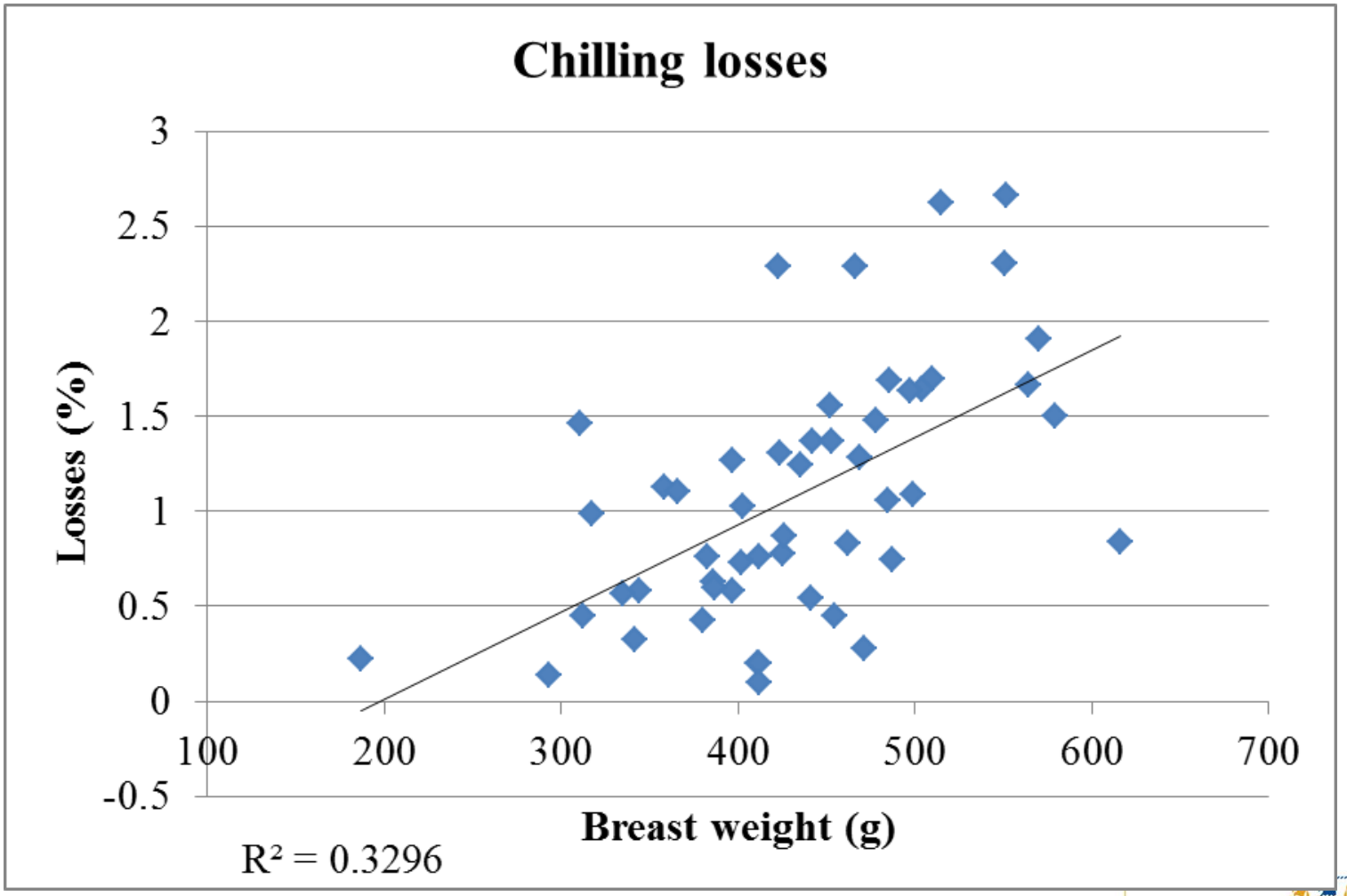


More protein => more breast weight

- Over the years greater protein deposition
- => better FCR
- => increased breast weight
- => need to revise nutrient requirements to match genetic potential from time to time and it's all good …

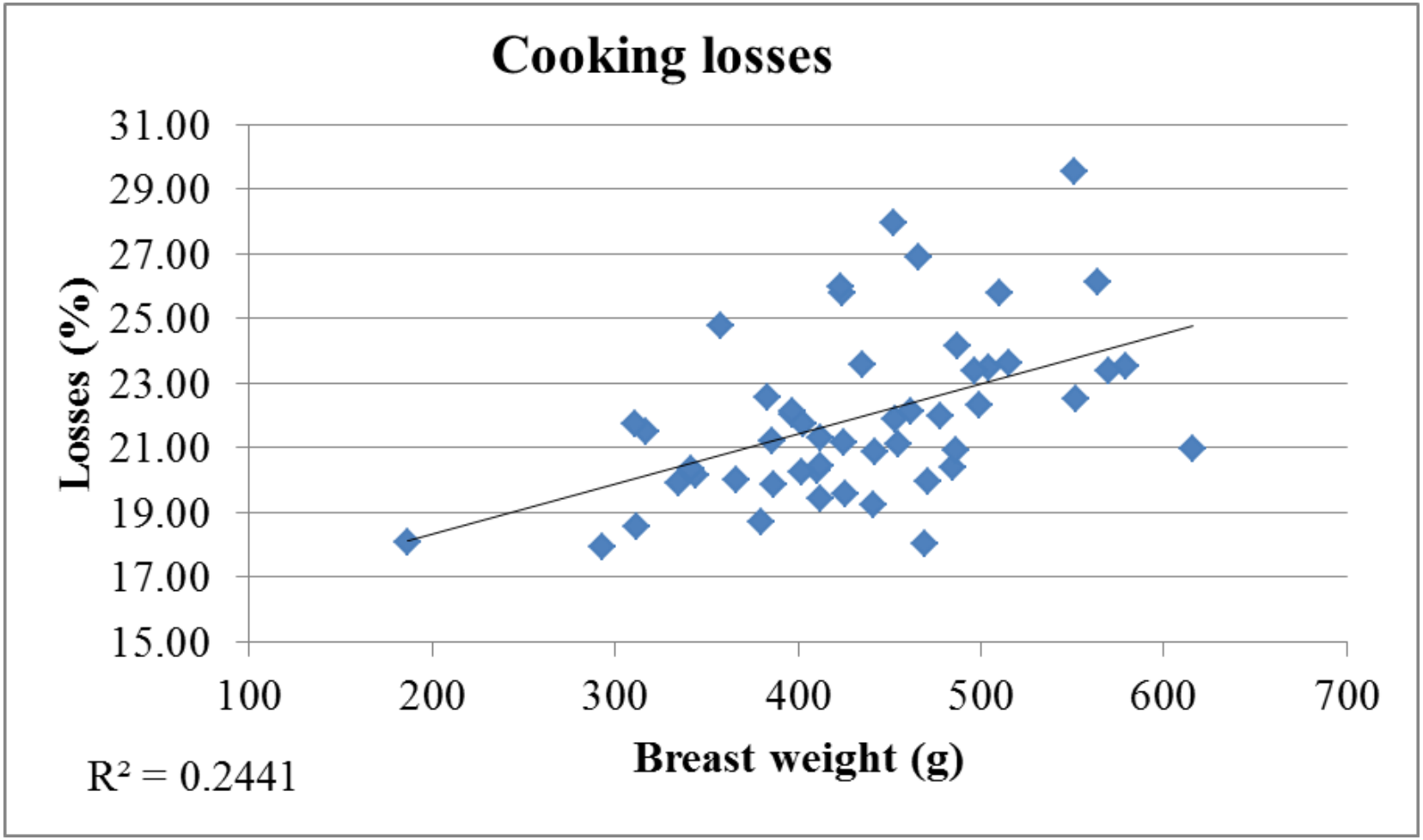
Or is it ?

Meat quality and Breast weight (at 42 days of age)



Chilled at 1°C for 48 hours.

Meat quality and Breast weight (at 42 days of age)



25mm steaks cooked in a water bath at 70° C for 90 min.

Conclusion

- Knowing the protein deposition rate potential of modern broiler chicken is essential to formulate diets which nutrient utilisation and maximize profitability.
- Overall, an increase in body protein content and its associated deposition rate has a beneficial effect on FCR and increased breast weight; two of the main drivers of profitability for broiler chicken production
- However, increase in breast weight could have a negative effect on meat quality …