MATHEMATICAL MODELING OF DIETARY AND CALORIC RESTRICTION INFLUENCE ON MEXFLY LONGEVITY

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EXPERIMENT

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*
SUGAR	**28.2**	**3.8**	**30.1**	**6.7**	**31.1**	**7.1**	**33.4**	**4.7**	**36.8**	**7.6**	**4.0**	**0.0**
24 : 1	**45.5**	**25.3**	**49.9**	**16.6**	**51.8**	**18.0**	**57.4**	**25.0**	**48.0**	**48.3**	**4.0**	**0.0**
9 : 1	**55.6**	**178.6**	**64.5**	**221.0**	**63.4**	**239.4**	**67.2**	**281.8**	**46.8**	**201.8**	**4.1**	**0.0**
3 : 1	**51.3**	**875.3**	**52.4**	**890.8**	**55.2**	**1085.7**	**53.9**	**866.5**	**30.0**	**191.4**	**3.9**	**0.0**

MAXIMAL LIFE EXPECTANCY

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*
SUGAR	**28.2**	**3.8**	**30.1**	**6.7**	**31.1**	**7.1**	**33.4**	**4.7**	**36.8**	**7.6**	**4.0**	**0.0**
24 : 1	**45.5**	**25.3**	**49.9**	**16.6**	**51.8**	**18.0**	**57.4**	**25.0**	**48.0**	**48.3**	**4.0**	**0.0**
9 : 1	**55.6**	**178.6**	**64.5**	**221.0**	**63.4**	**239.4**	**67.2**	**281.8**	**46.8**	**201.8**	**4.1**	**0.0**
3 : 1	**51.3**	**875.3**	**52.4**	**890.8**	**55.2**	**1085.7**	**53.9**	**866.5**	**30.0**	**191.4**	**3.9**	**0.0**

MAXIMAL REPRODUCTION

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*	e_0	*eggs*
SUGAR	**28.2**	**3.8**	**30.1**	**6.7**	**31.1**	**7.1**	**33.4**	**4.7**	**36.8**	**7.6**	**4.0**	**0.0**
24 : 1	**45.5**	**25.3**	**49.9**	**16.6**	**51.8**	**18.0**	**57.4**	**25.0**	**48.0**	**48.3**	**4.0**	**0.0**
9 : 1	**55.6**	**178.6**	**64.5**	**221.0**	**63.4**	**239.4**	**67.2**	**281.8**	**46.8**	**201.8**	**4.1**	**0.0**
3 : 1	**51.3**	**875.3**	**52.4**	**890.8**	**55.2**	**1085.7**	**53.9**	**866.5**	**30.0**	**191.4**	**3.9**	**0.0**

CONCENTRATIONS

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	Sug	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*
SUGAR	**33.0**	**0**	**25.0**	**0**	**16.7**	**0**	**8.3**	**0**	**3.3**	**0**	**0**	**0**
24 : 1	**32.1**	**1.3**	**24.0**	**1.0**	**16.0**	**0.7**	**8.0**	**0.3**	**3.2**	**0.1**	**0**	**0**
9 : 1	**30.0**	**3.3**	**22.5**	**2.5**	**15.0**	**1.7**	**7.5**	**0.8**	**3.0**	**0.3**	**0**	**0**
3 : 1	**25.0**	**8.3**	**18.8**	**6.2**	**12.5**	**4.2**	**6.2**	**2.1**	**2.5**	**0.8**	**0**	**0**

CONCENTRATIONS

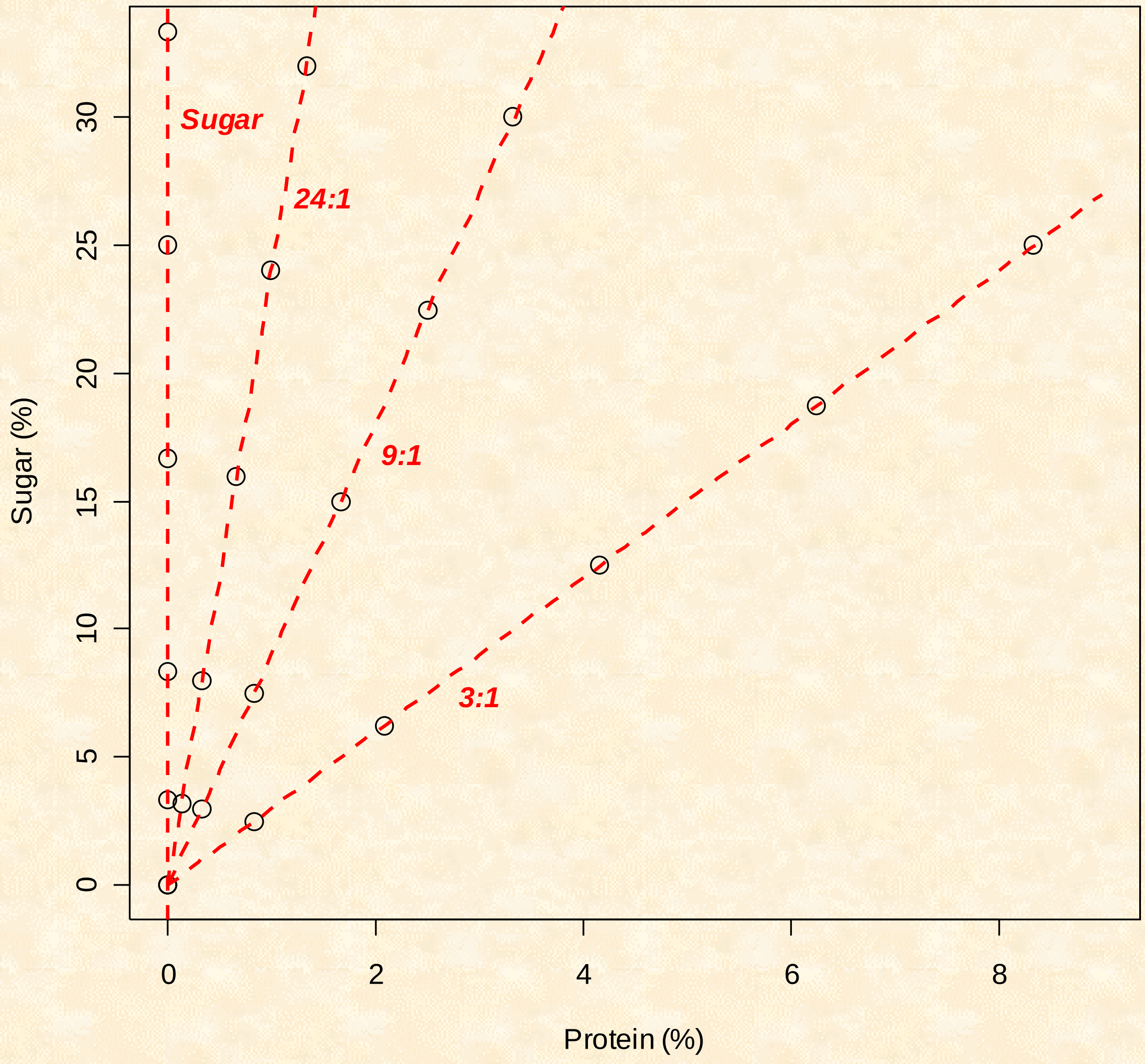
maximal life expectancy

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	Sug	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*
SUGAR	**33.0**	**0**	**25.0**	**0**	**16.7**	**0**	**8.3**	**0**	**3.3**	**0**	**0**	**0**
24 : 1	**32.1**	**1.3**	**24.0**	**1.0**	**16.0**	**0.7**	**8.0**	**0.3**	**3.2**	**0.1**	**0**	**0**
9 : 1	**30.0**	**3.3**	**22.5**	**2.5**	**15.0**	**1.7**	**7.5**	**0.8**	**3.0**	**0.3**	**0**	**0**
3 : 1	**25.0**	**8.3**	**18.8**	**6.2**	**12.5**	**4.2**	**6.2**	**2.1**	**2.5**	**0.8**	**0**	**0**

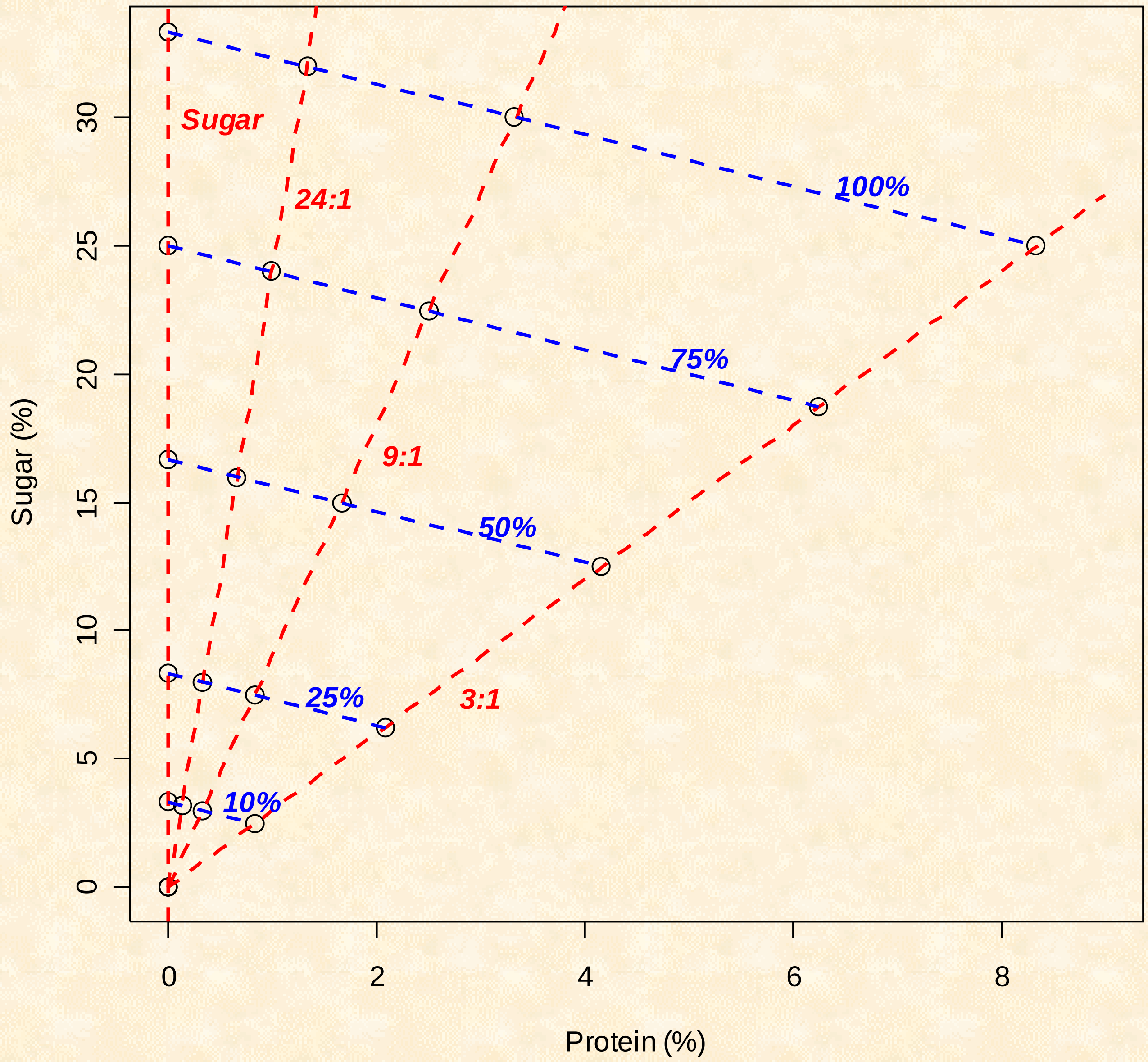
CONCENTRATIONS
maximal reproduction

	DILUTION											
	100%		75%		50%		25%		10%		0%	
	Sug	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*	*Sug*	*Prot*
SUGAR	**33.0**	**0**	**25.0**	**0**	**16.7**	**0**	**8.3**	**0**	**3.3**	**0**	**0**	**0**
24 : 1	**32.1**	**1.3**	**24.0**	**1.0**	**16.0**	**0.7**	**8.0**	**0.3**	**3.2**	**0.1**	**0**	**0**
9 : 1	**30.0**	**3.3**	**22.5**	**2.5**	**15.0**	**1.7**	**7.5**	**0.8**	**3.0**	**0.3**	**0**	**0**
3 : 1	**25.0**	**8.3**	**18.8**	**6.2**	**12.5**	**4.2**	**6.2**	**2.1**	**2.5**	**0.8**	**0**	**0**

CONCENTRATIONS



CONCENTRATIONS



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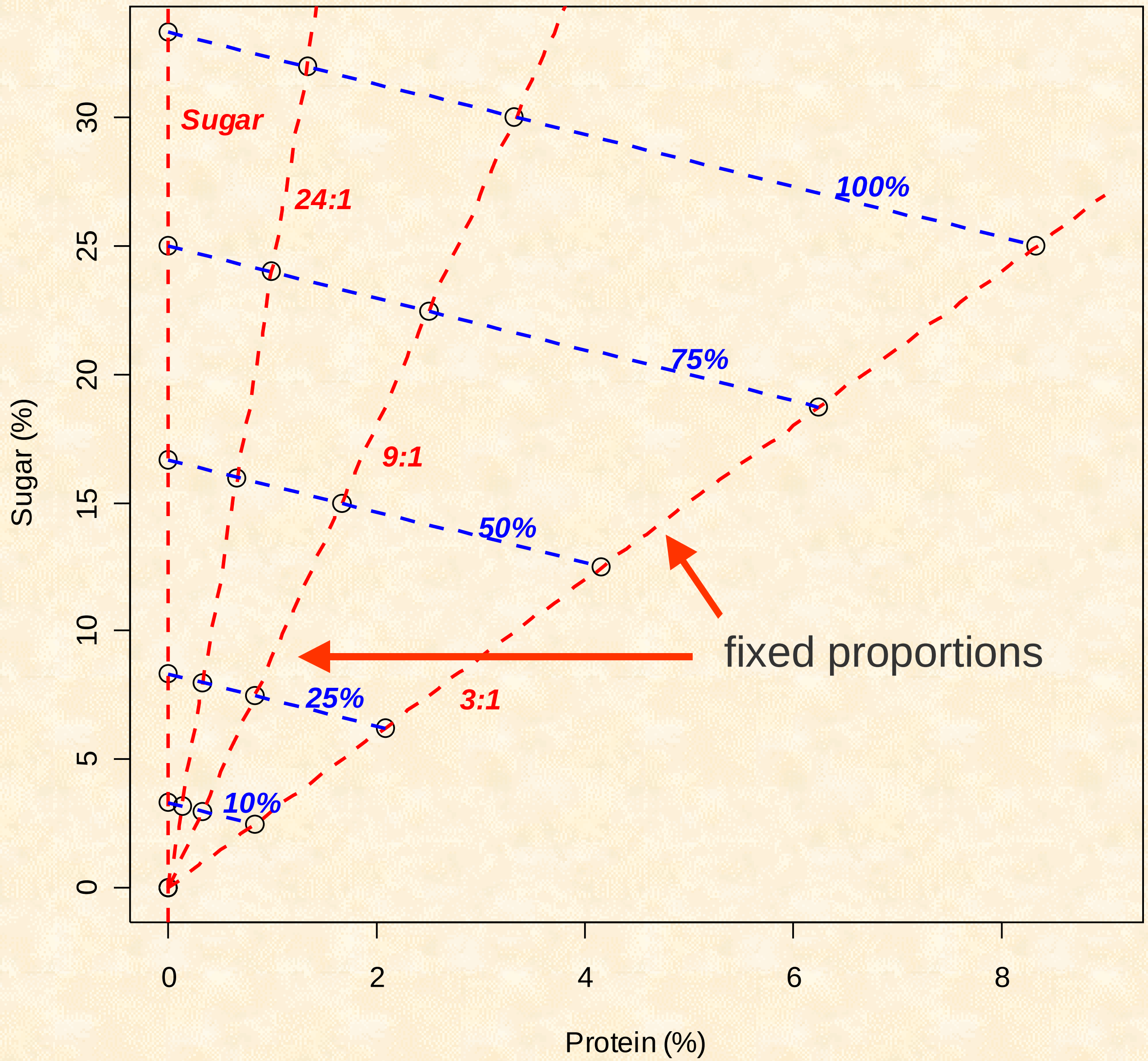
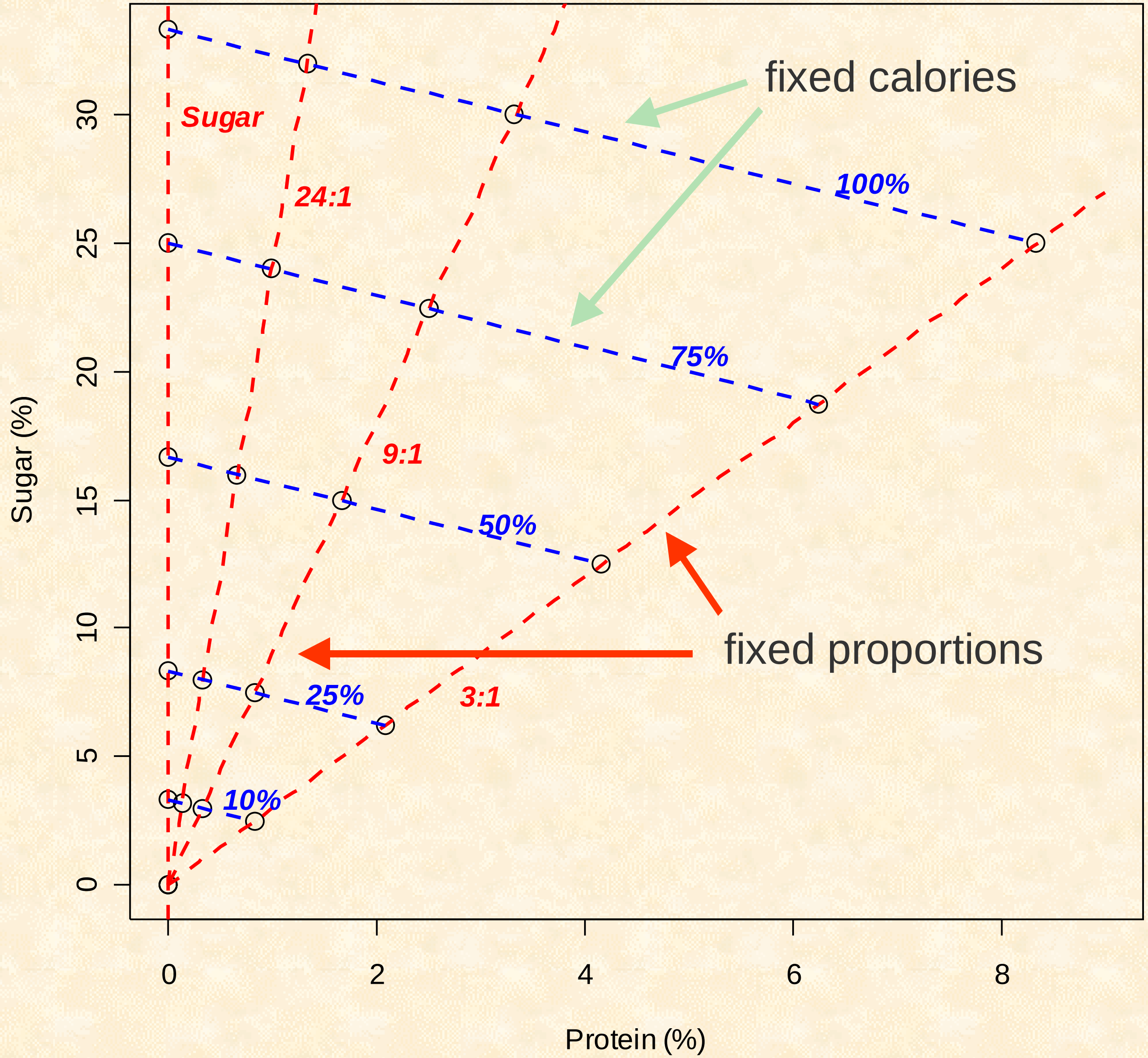
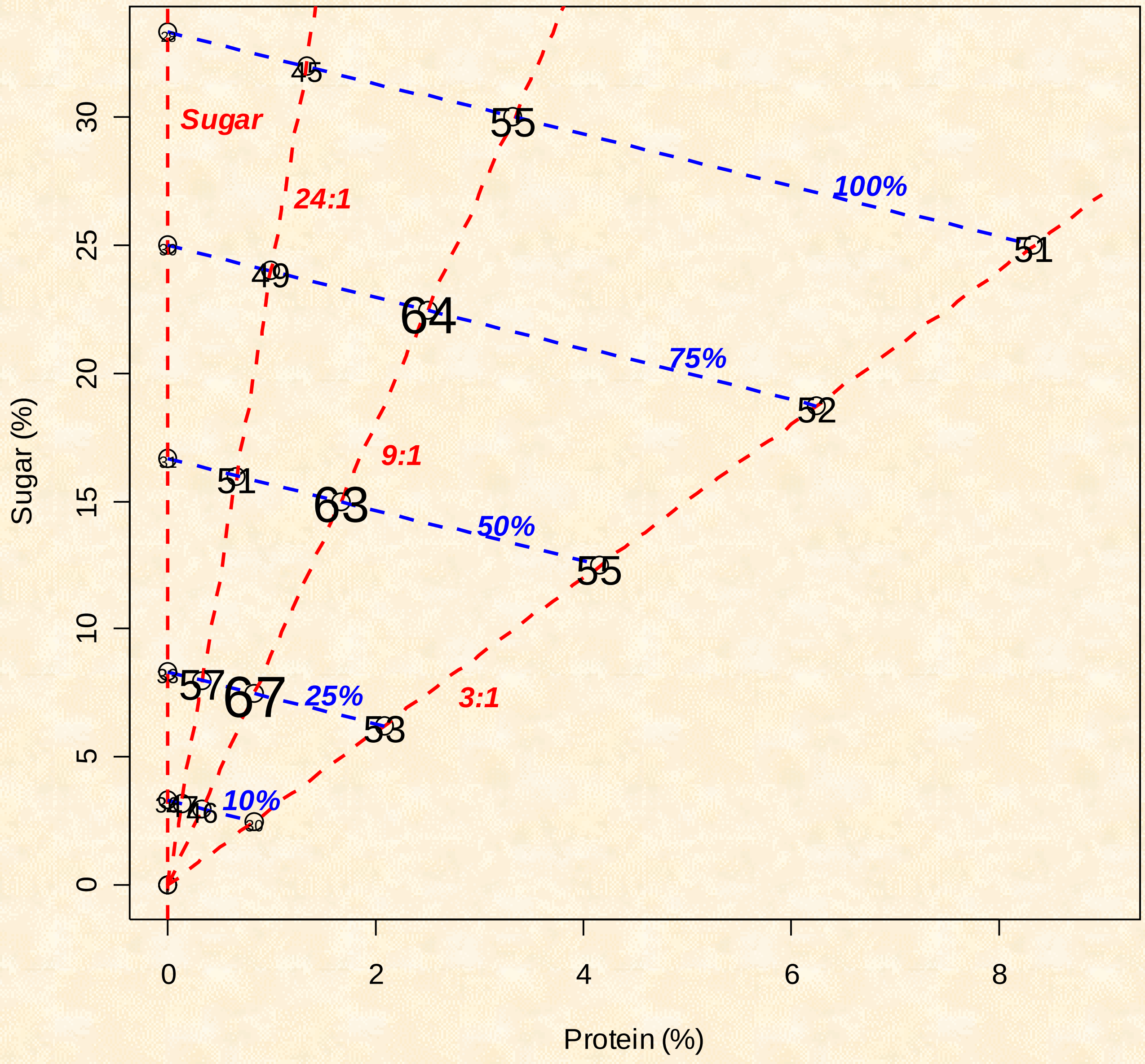


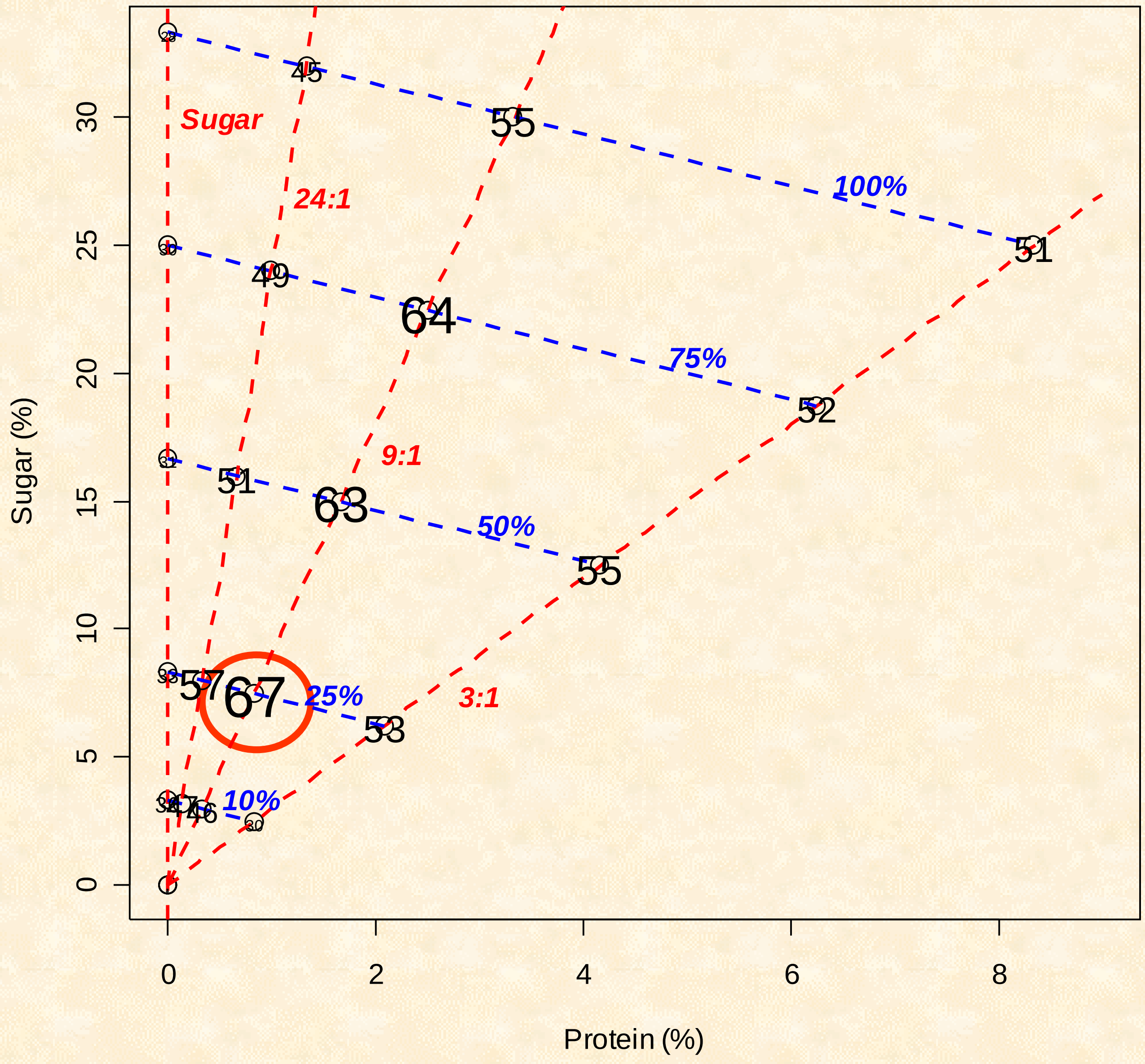
CONCENTRATIONS



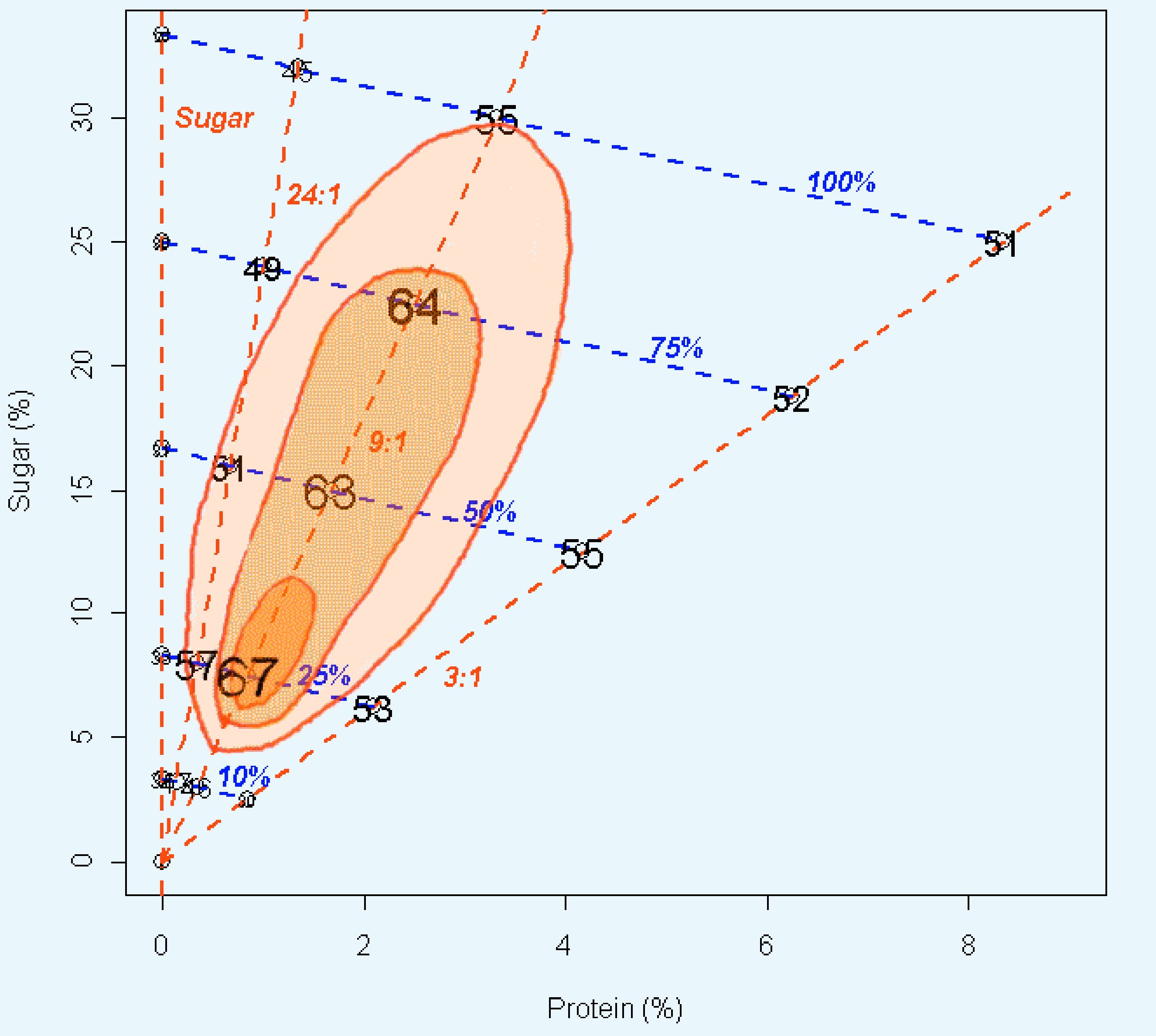
MEAN LIFE SPAN



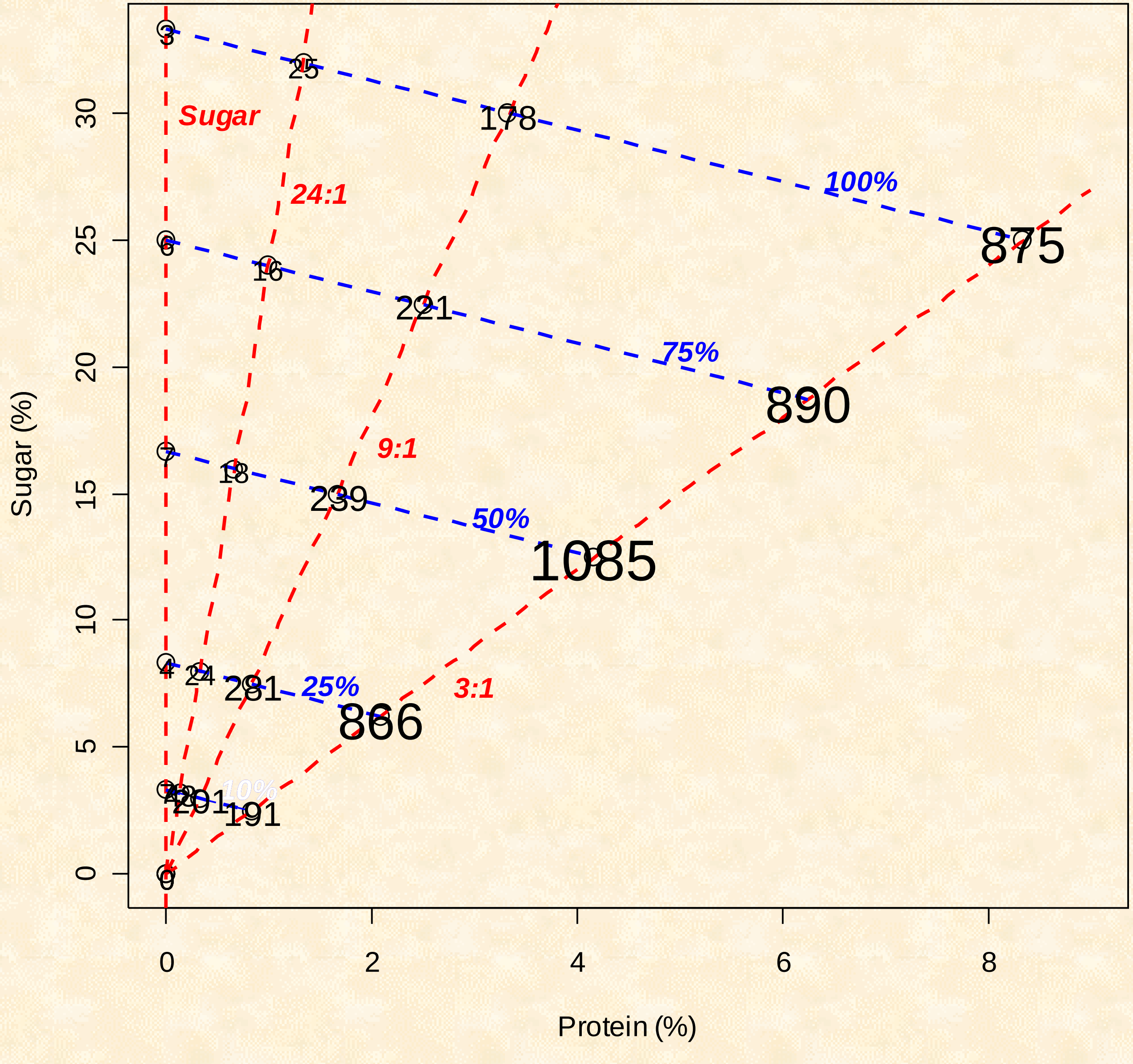
MEAN LIFE SPAN



MEAN LIFE SPAN



REPRODUCTION



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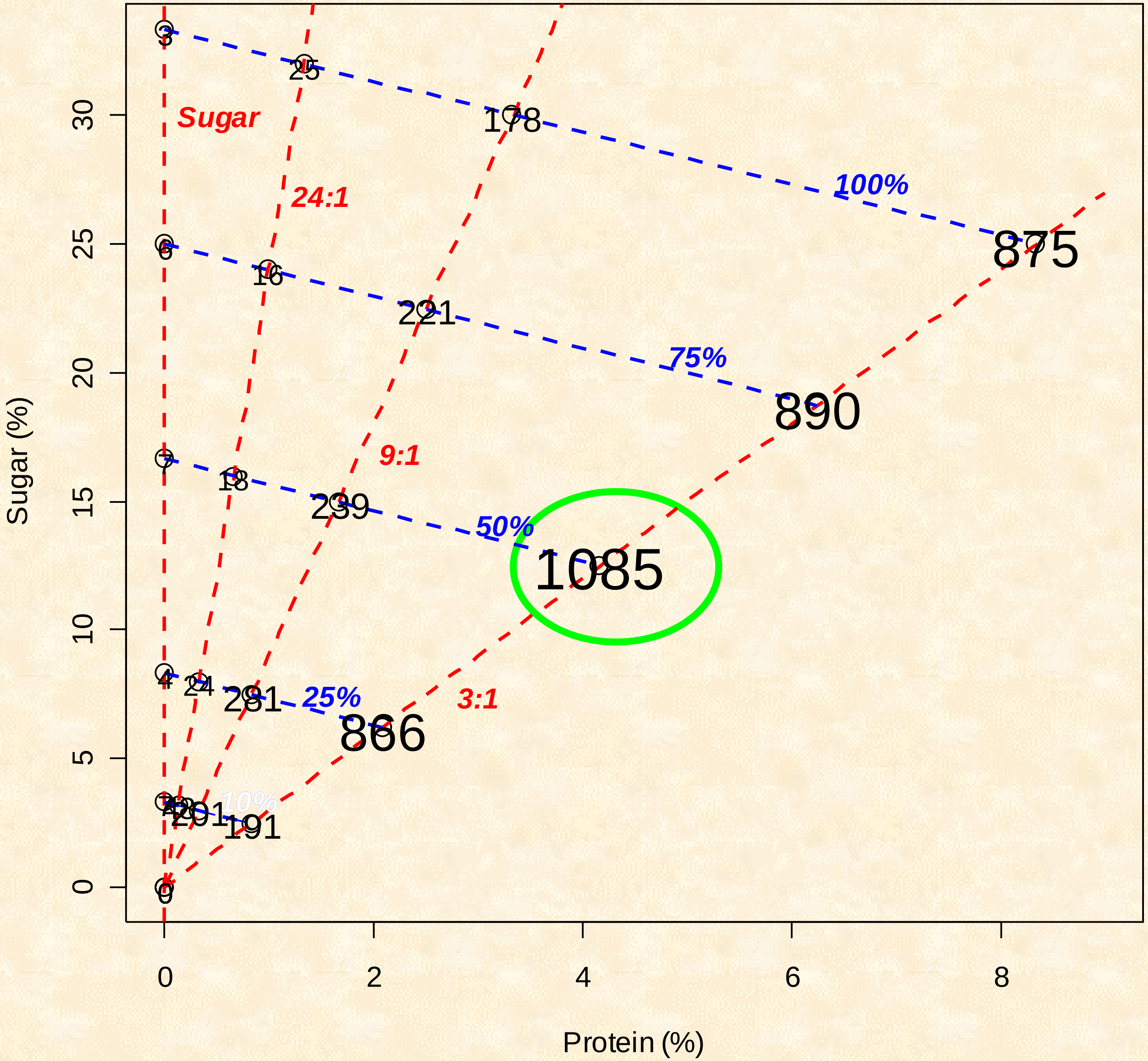
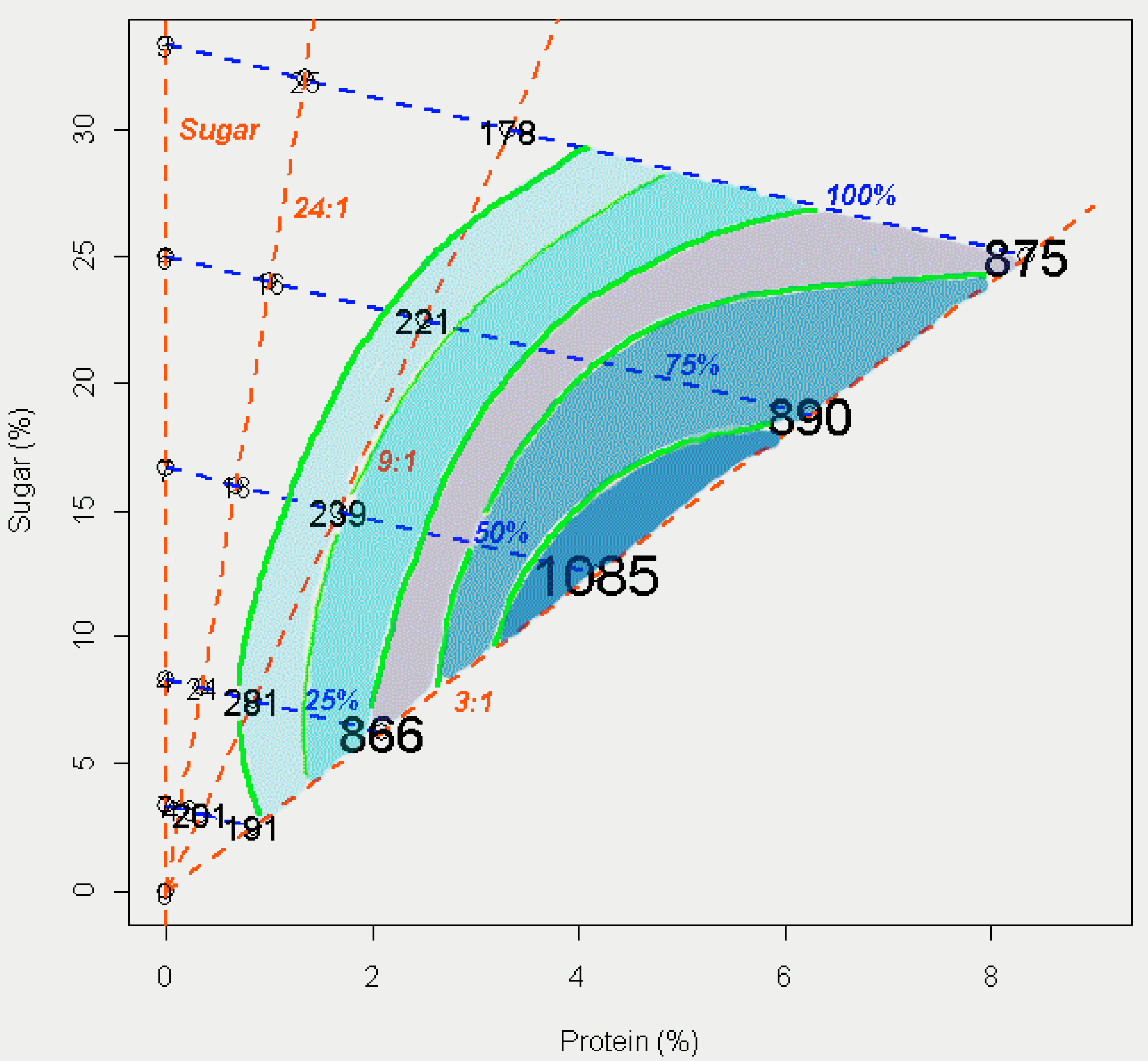


REPRODUCTION



Reproduction depends both on calorie intake and protein concentration

ENERGY FOR REPRODUCTION MODELING

$$E_r = E_p - k_1 E_m f\left(E_p\right)$$

Energy allocated for reproduction proportional to the amount of protein in food minus amount of protein spent for reparation of damages

ENERGY FOR REPRODUCTION MODELING

$$E_r = E_p - k_1 E_m f\left(E_p\right)$$

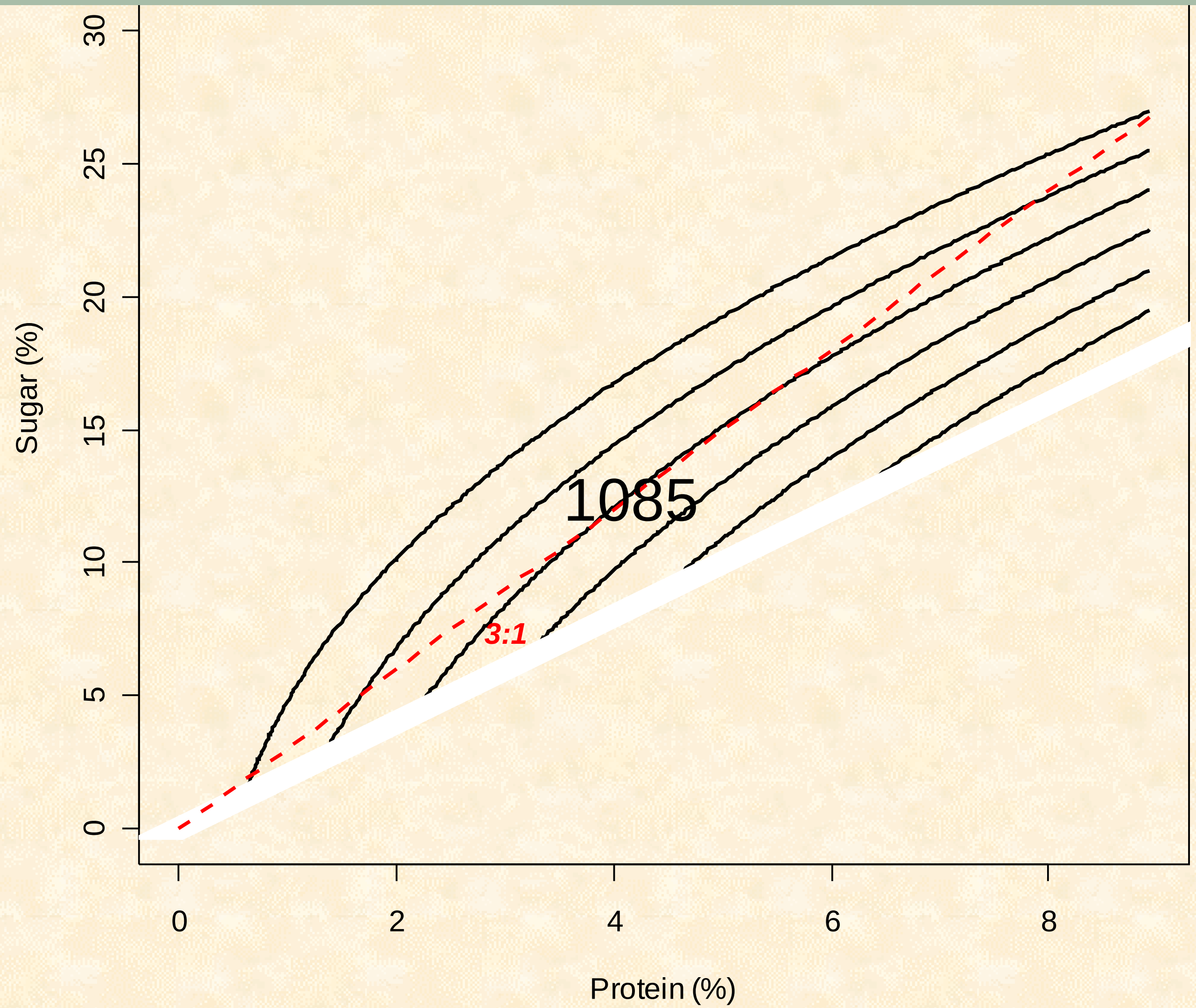
$$E_m = E_s - l_1 E_r j\left(E_s\right)$$

Energy allocated for maintenance proportional to the amount of sugar in food minus amount of sugar spent for reproduction

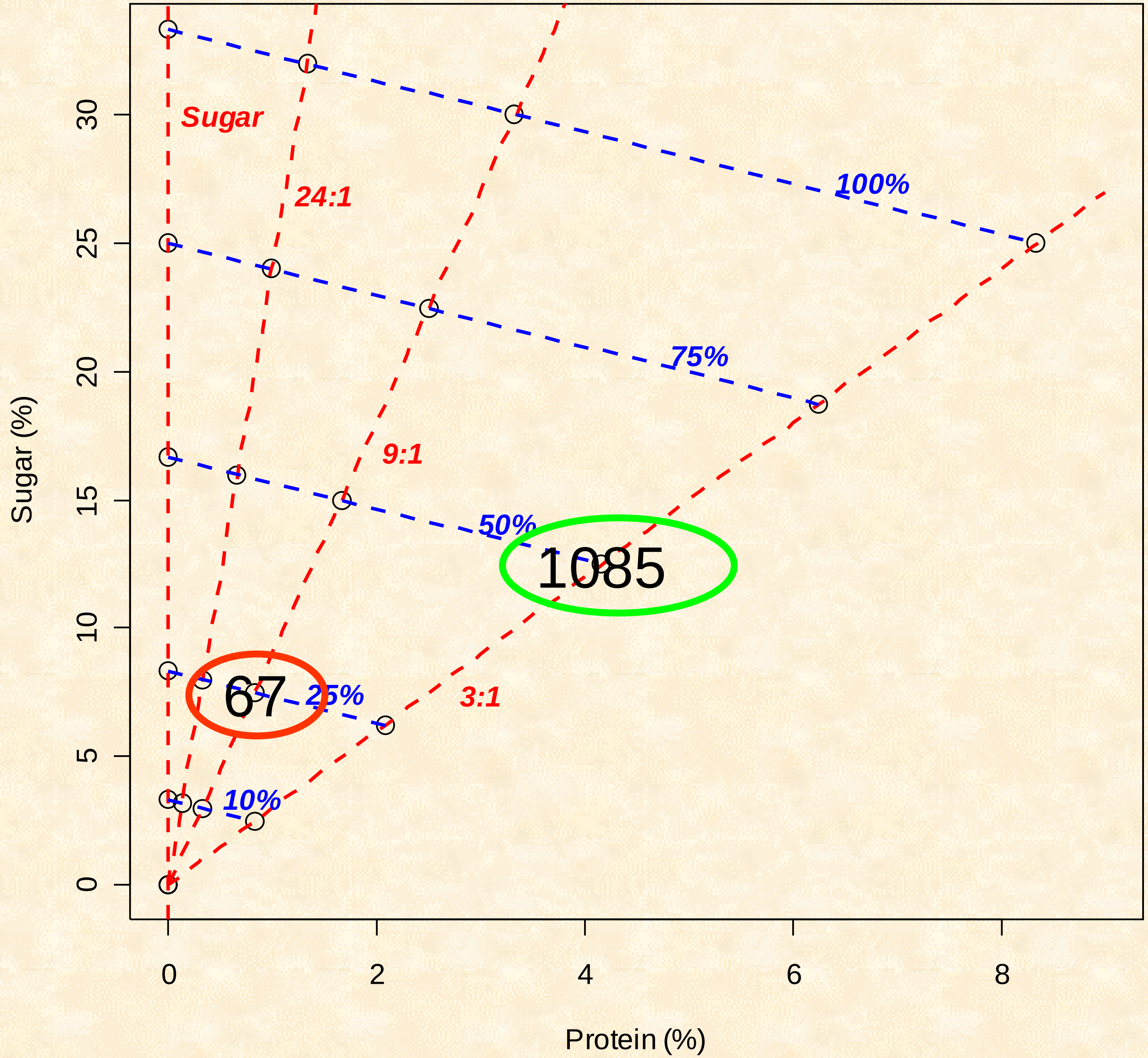
ENERGY FOR REPRODUCTION MODELING

$$E_r = \frac{E_p - k_1 f\left(E_p\right)E_s}{1 - k_1 l_1 f\left(E_p\right) j\left(E_s\right)}$$

ENERGY FOR REPRODUCTION MODELING *EXAMPLE*



REPRODUCTTION vs. MEAN LIFE SPAN



LONGEVITY MODELING

Mortality model

$$m(x) = a \exp(bx)$$

LONGEVITY MODELING

Mortality model

$$m(x) = a \exp(bx)$$

Strehler and Mildvan model

$$a = K \exp(-V_0 / e) \qquad b = V_0 B / e$$

Vitality

$$V(x) = V_0 (1 - Bx)$$

LONGEVITY MODELING

Mortality model $$V_0 = E_m$$

$$m(x) = a \exp(bx)$$

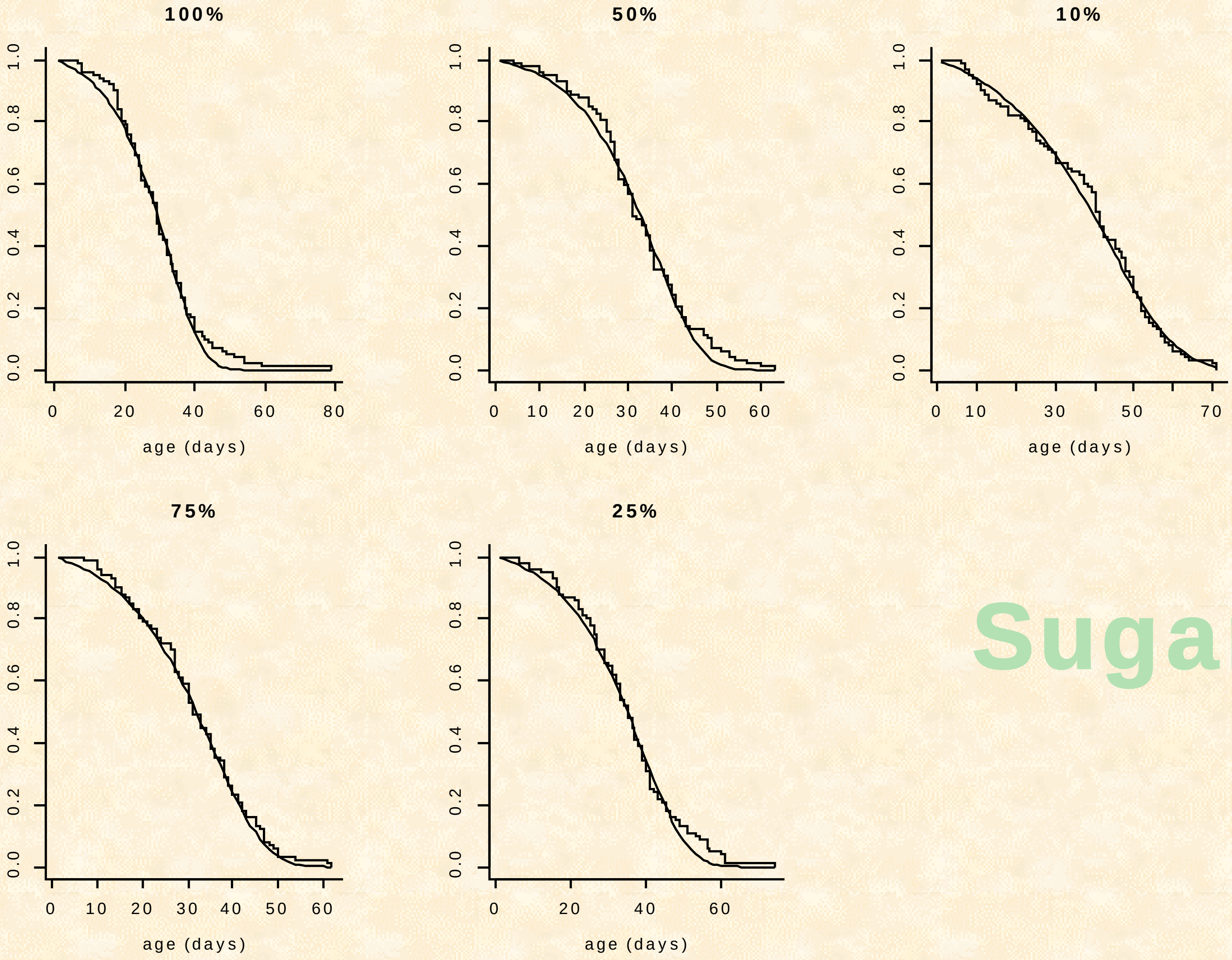
Strehler and Mildvan model

$$a = K \exp(-V_0 / e) \qquad b = V_0 B / e$$

Vitality

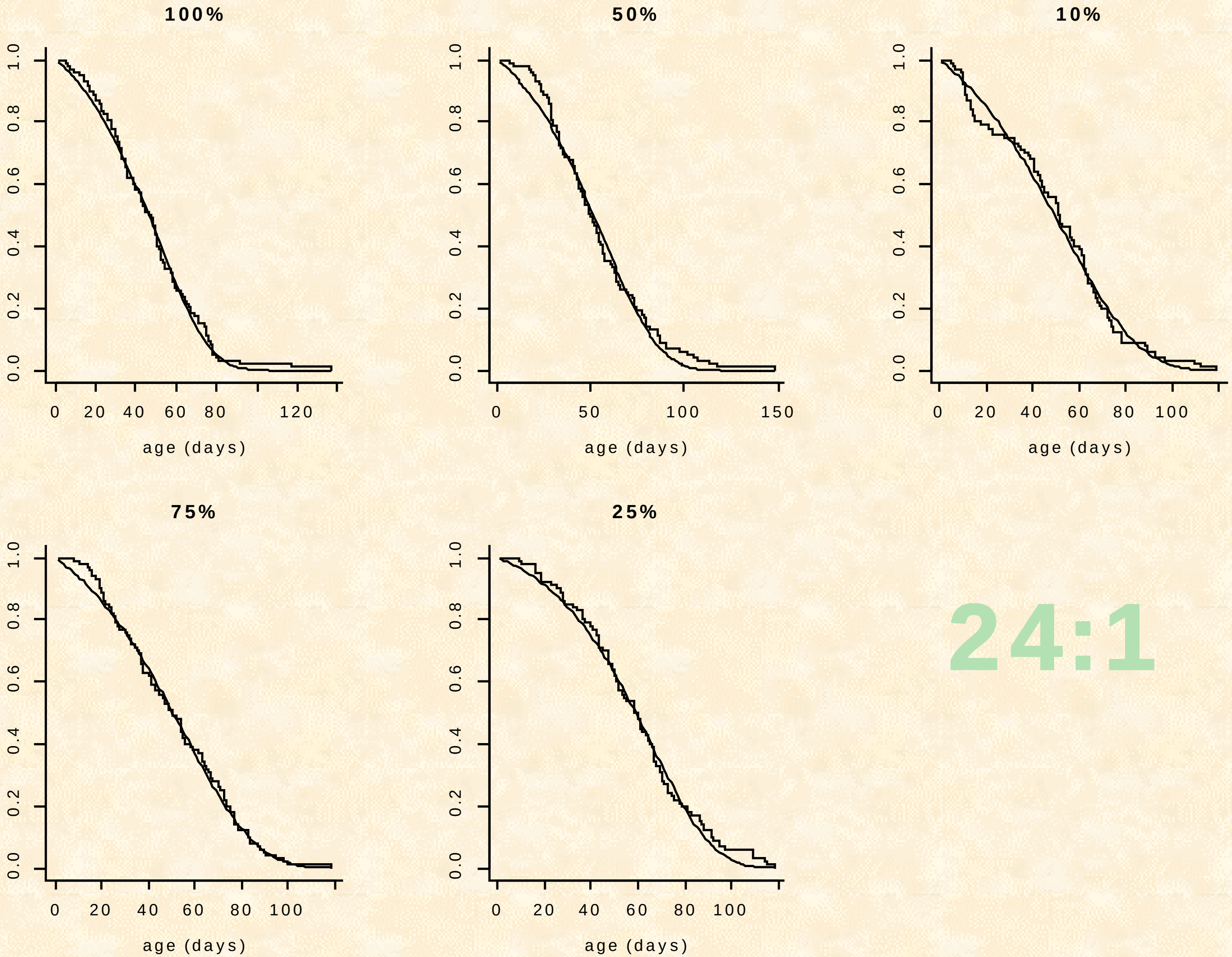
$$V(x) = V_0 (1 - Bx)$$

LONGEVITY MODELING *RESULTS*



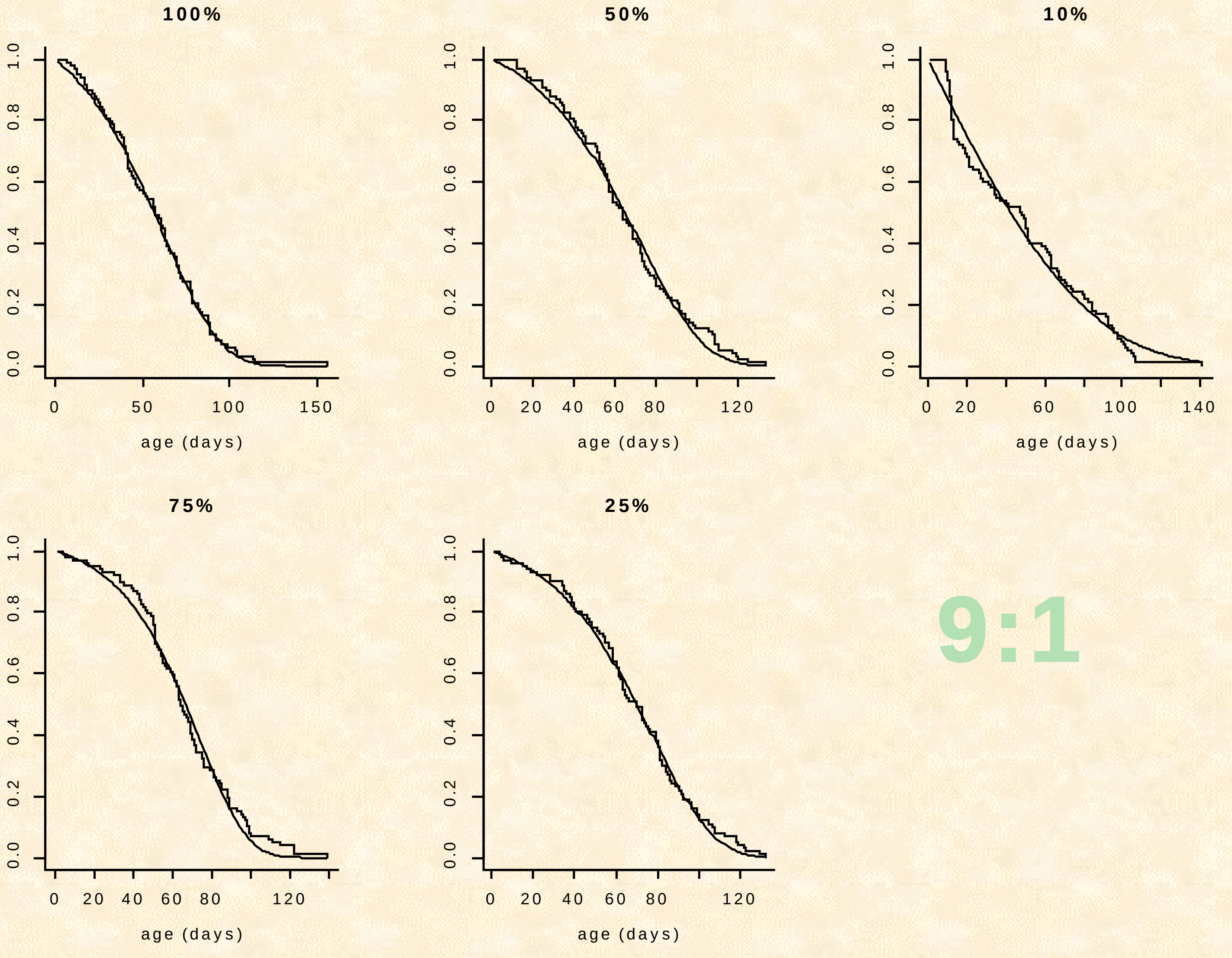
Sugar

LONGEVITY MODELING *RESULTS*



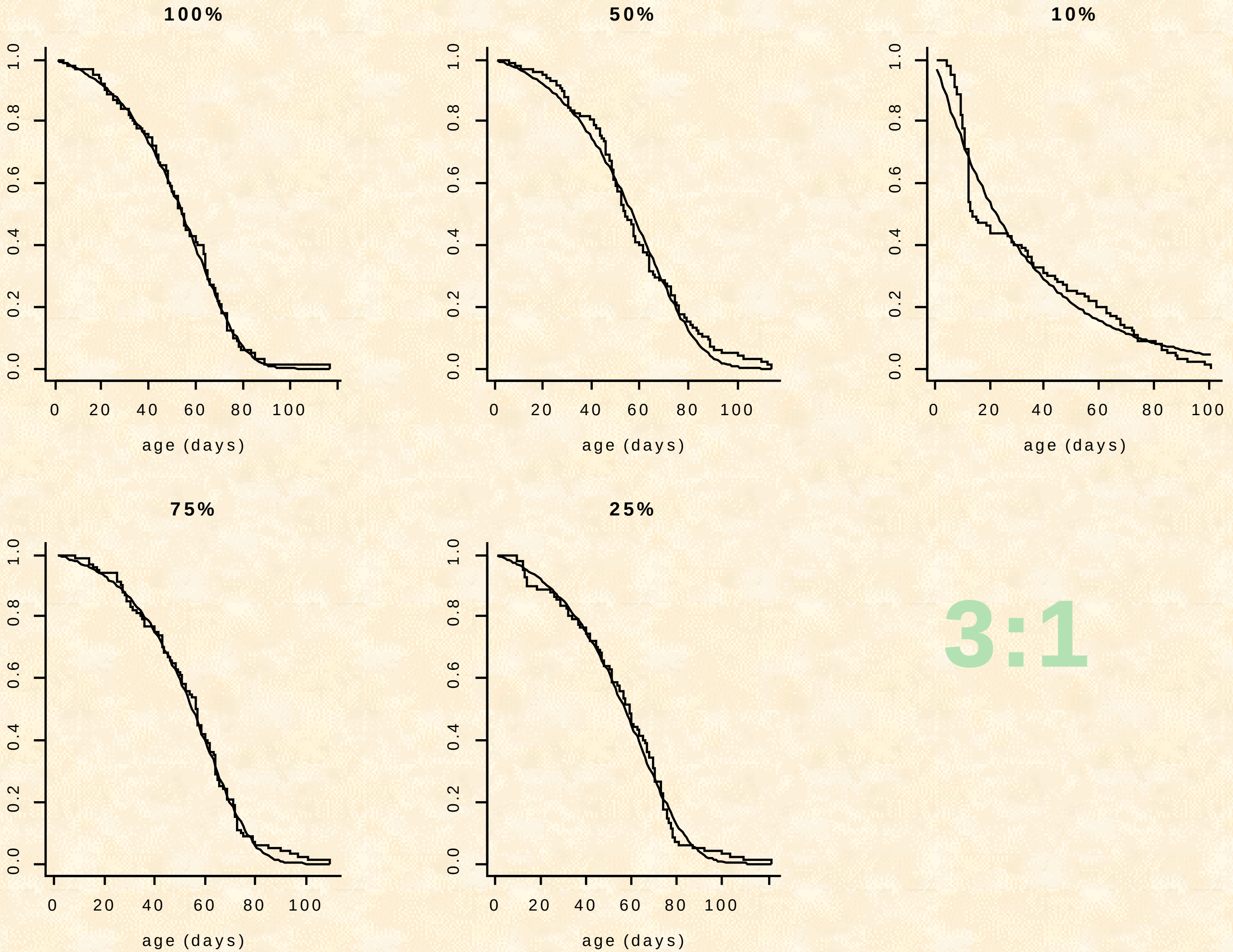
24:1

LONGEVITY MODELING *RESULTS*



9:1

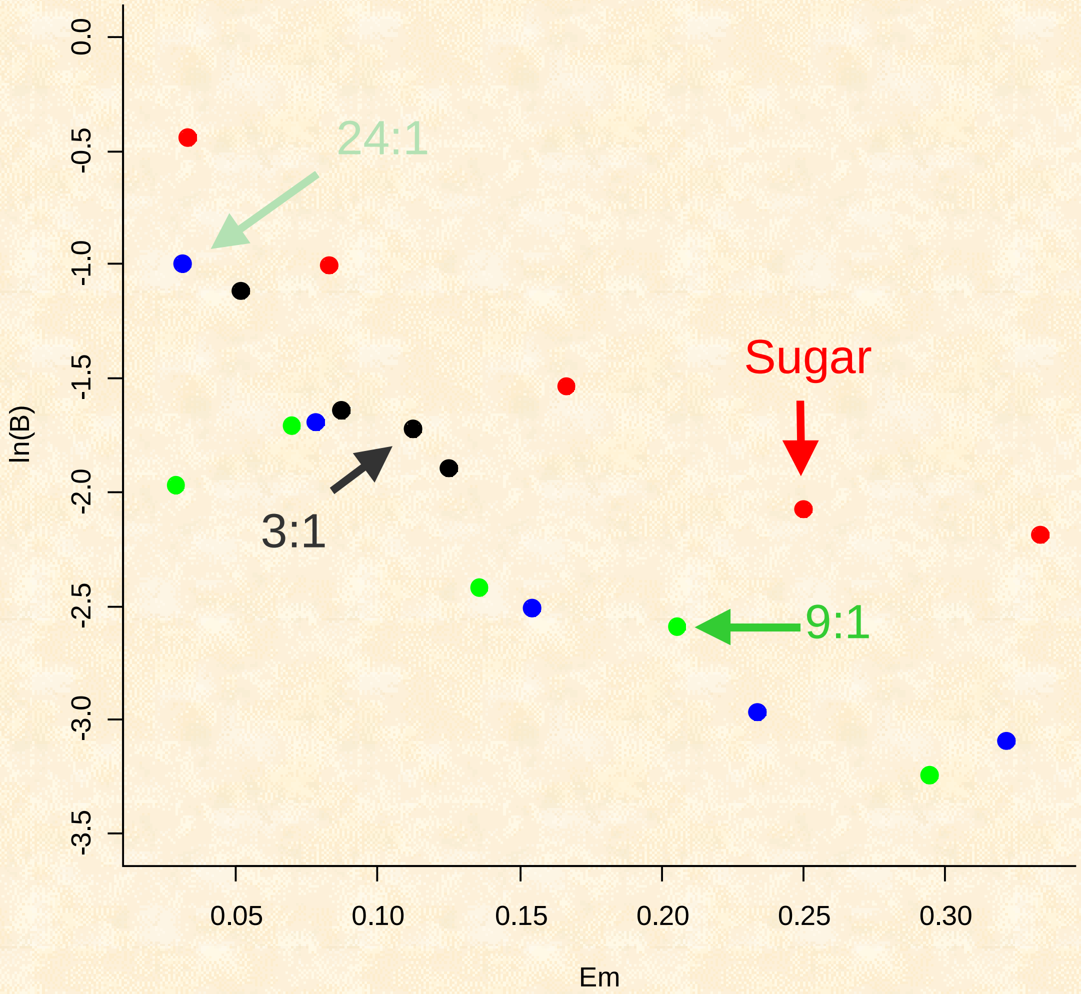
LONGEVITY MODELING *RESULTS*



3:1

LONGEVITY MODELING

RESULTS: lnB(E_m)



CONCLUSIONS

- Calorie intake is not the main factor in the longevity extension
- Life span is extended to a greater extent by reducing protein concentration than by reducing sugar concentration
- Rate of vitality decline with age decreases with increase of energy spent for maintenance