Are there any global indicators of early and late stress response in beef cattle?

J.O. Rosa[1], M.J. Carabaño[2], J. de la Fuente[3] C. Meneses[2], C. Gonzalez[2], C. Pérez[3], D.P. Munari[1], C.Diaz[2]

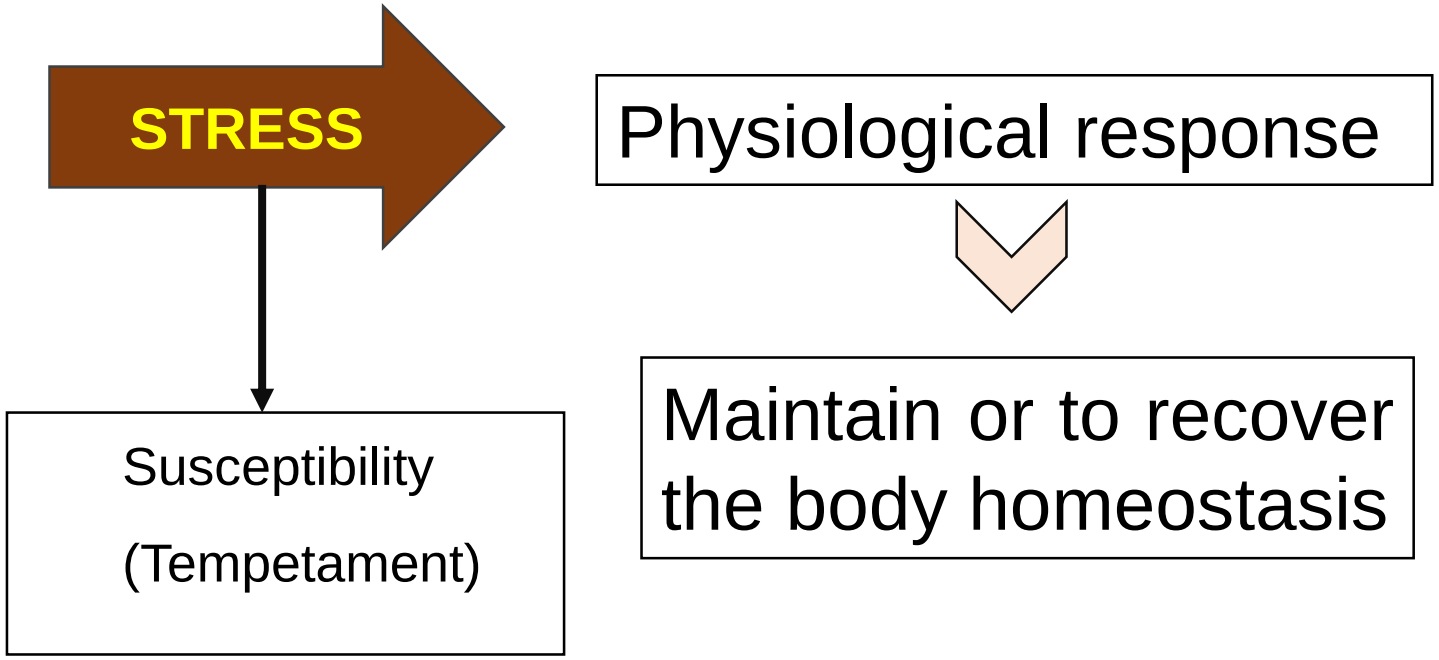
[1]FCAV/UNESP,Jaboticabal, SP, Brazil

[2]INIA, Dpto. Mejora Genética Animal, Ctra. La Coruña Km 7.5, 28040 Madrid, Spain

[3] UCM, Dpto. Producción Animal, 28040 Madrid, Spain

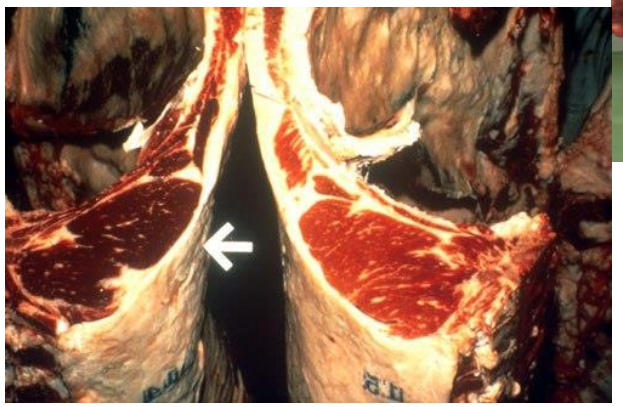
Stress Response

- Usual handling stress
  - Passage through the chutes
  - Human presence
- Pre-slaughter stress
  - Load in truck
  - Transport
  - Unloading in slaughterhouse
  - Wait in pens
  - Conduction aisle to the stunning box
  - Stunning box



Why study stress?

- Social value: Animal Welfare
- Easy handling
- Lower carcass yield and more carcass injuries



- Reduced meat quality
- Worse reproductive, efficiency and immune status of the animal

Understanding the complex responses of cattle subject handling

- Search via selection less reactive animals to avoid losses.
- Improve animal welfare and performance and meat quality

The aim of the present study is to:

- **characterize the response to stress in two different periods, feedlot handling (F) and slaughter handling (S)**
- **to evaluate if the early response in F could be used to predict response at S using a set of biomarkers of stress in beef cattle**

Material and Methods

- Blood samples of 80 Avileña-Negra Iberica male calves were collected in 2 time points: the **feedlot** (**F**) (between 4 and 7 days before finishing) and at the **slaughterhouse** (**S**) during exsanguination

- 7 biomarkers **(albumin, cortisol, creatine kinase, glucose, lactate, lactate dehydrogenase and globulin)** were determined in blood plasma

Material and Methods

- **Principal Component Analysis (PCA) to characterize physiogical components stress response**

- **Logistic Regression + Linear Discriminant Analysis to identify a subset of the biomarkers of stress that best discriminate between the 2 stress situations**

Results. PCA at feedlot

Feedlot	Dim.1	ctr	Dim.2	ctr	Dim.3	ctr
Albumin	0.15	1.15	0.58	21.53	0.24	4.94
CK	0.21	2.29	-0.05	0.15	**0.83**	60.67
Cortisol	0.64	21.24	0.56	19.89	0.07	0.37
Globulin	0.44	9.96	0.48	14.96	0.31	8.63
Glucose	0.7	26.05	0.38	9.44	-0.36	11.26
Lactate	0.25	3.36	**0.73**	33.92	-0.22	4.3
LDH	**0.83**	35.95	0.04	0.12	0.34	9.85

% of variance PC1 = 27.16 PC2 = 22.2 PC3 = 16.34

TOTAL VARIANCE EXPLAINED: 65.6

Results. PCA at the slaughterhouse

Slaugthter house	Dim.1	ctr	Dim.2	ctr	Dim.3	ctr
Albumin	0.62	18	0.31	5.74	0.35	10.3
CK	0.29	3.96	0.2	2.53	**0.73**	46.1
Cortisol	0.69	22.3	-0.48	13.9	0.16	2.17
Globulin	0.46	9.62	-0.61	22.5	0.09	0.73
Glucose	0.57	14.9	0.37	8.57	-0.59	30.5
Lactate	**0.82**	30.9	0.26	4.09	-0.28	6.67
LDH	-0.08	0.3	**0.83**	42.7	0.21	3.65

% of variance PC1 = 30.8 PC2 = 23.3 PC3 = 16.6

TOTAL VARIANCE EXPLAINED: 70.6

Results. Contribution of each marker to the variance and weight of each trait.

Biomarkers	Feedlot		Slaughter House	
	Cont.	Weight	Cont.	Weight
Albumin	5.9	0.209	8.6	**0.511**
CK	10.6	0.182	9.4	**0.257**
Cortisol	10.2	**0.310**	10.5	0.127
Globulin	7.4	**0.277**	8.3	0.014
Glucose	11.0	0.216	11.6	0.164
Lactate	9.1	0.194	11.6	**0.267**
LDH	11.4	**0.290**	10.6	0.204

Results. Missmatching between Feedlot and Slaughter house

All biomarkers			Only lactate			Only CK			Best Model*		
	F	S		F	S		F	S		F	S
F	91.25	8.75	F	92.5	7.5	F	23.7	76.25	F	92.5	7.5
S	13.75	86.25	S	15	85	S	22.5	77.5	S	12.5	87.5

*Best Model=Albumin+Glucose+Lactate)

Results. Correlation between biomarkers of stress, Warner-Bratzler (WB) shear force and pH at 0 hours.

	WB	pH
Albumin_F	0.19	**-0.35**
Cortisol_F	0.05	-0.1
CK_F	0.05	-0.03
Glucose_F	-0.06	0.16
Lactate_F	**0.4**	**-0.29**
LDH_F	-0.05	0.06
Globulin_F	0.08	**-0.24**
Albumin_S	**0.43**	-0.1
Cortisol_S	**0.3**	-0.19
CK_S	0.11	0.02
Glucose_S	-0.05	-0.13
Lactate_S	**0.07?**	**-0.1**
LDH_S	-0.03	**0.25**
Globulin_S	0.16	-0.17

Conclusions

- The physiological response to stress was different in F and S, therefore, **the stress response is modulated by different mechanisms depending on the stress situation**

- At **F: LDH, CORTISOL AND GLOBULINE** had the most important contribution
- At **S: LACTATE, ALBUMINA AND CK** were the main indicator of stress

muscle response → negative impact on meat quality

- **LACTATE, GLUCOSE AND ALBUMINA best discriminate the two different stress conditions**

- **The others maybe global stress markers and therefore they could be used in combination as a selection criteria.**

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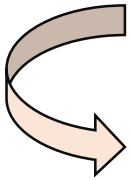
Temperament and effects of stress



Depends on its genetic background, prior experience, the types and the duration of the stressors, age, sex, etc.

- Individuals with a very excitable temperament may become increasingly stressed

  - **More difficult to handle**
  - **Carcasses with greater incidence of injuries**
  - **Inferior meat quality traits**
  - **Growth rates, reproduction and immune functions reduced**