EFFECT OF ENVIRONMENTAL ENRICHMENT ON STRESS MARKERS IN GOATS

THE 34TH ANNUAL CONFERENCE ON CATTLE AND SHEEP SCIENCE

Dr. Yossi Wein, D.V.M
Ph.D. Immunology

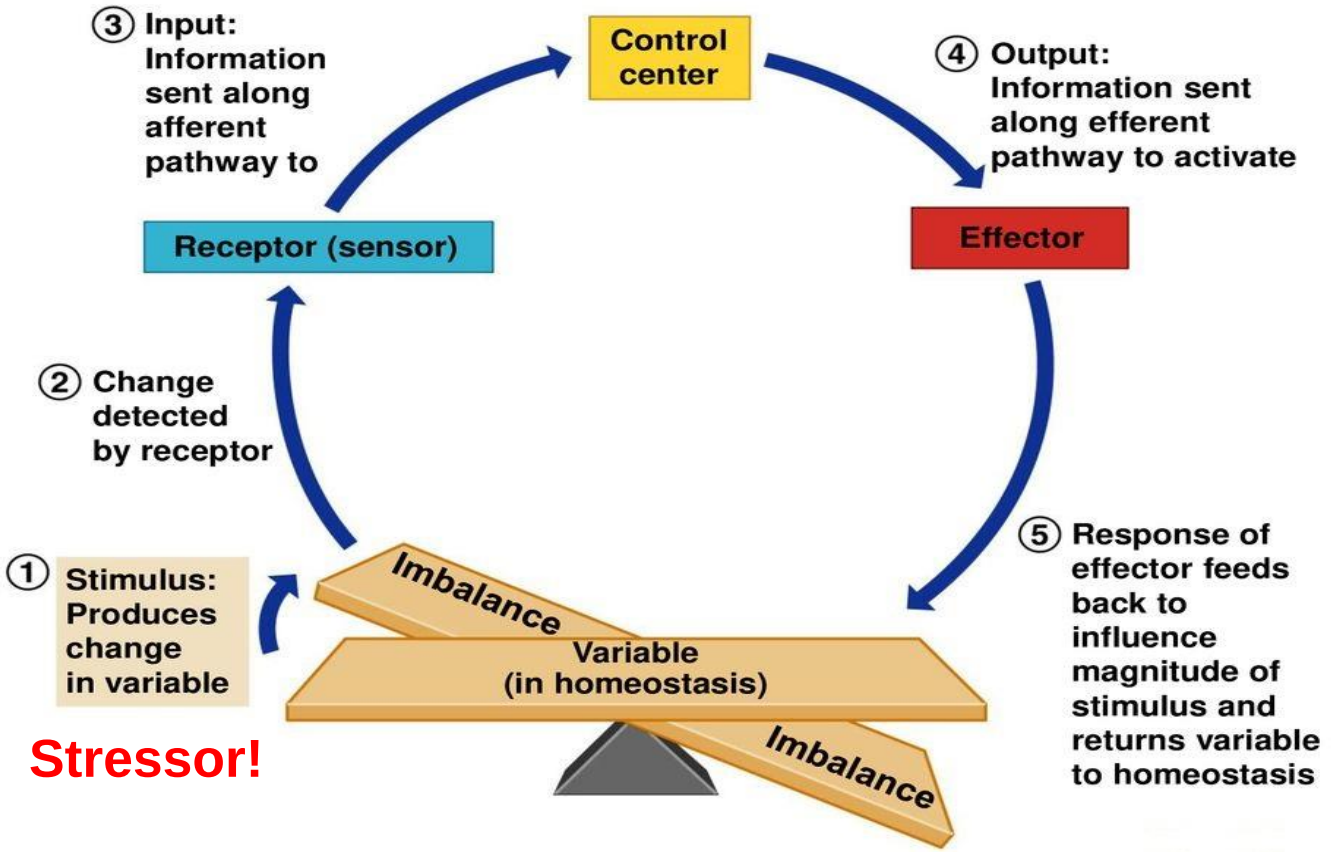
Department of Animal Sciences
The Robert H. Smith Faculty of Agriculture, Food and Environment
The Hebrew University of Jerusalem

Physiological equilibrium (= homeostasis)

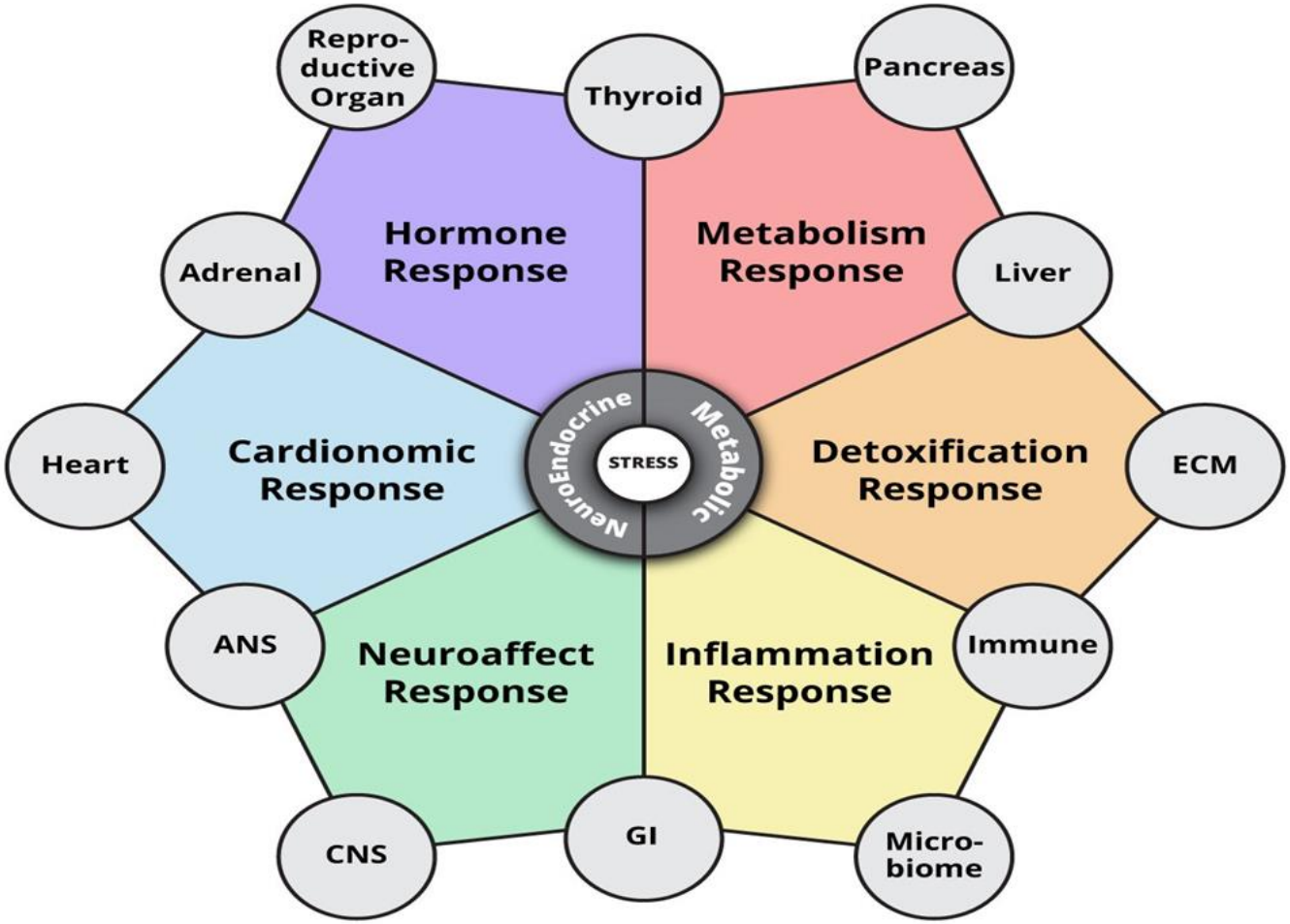
The state of steady internal physical and chemical conditions maintained by living systems.

This includes many metabolic – biochemical processes regulated in face of changes in the environment, diet, or level of activity.

Stress – the loss of homeostasis



Restoration of homeostasis is a multi-system procedure



It is all about channeling & utilizing all available resources!

The necessity for evaluating stress in farm animals

- **Animal welfare – represents the way we look after animals**

- **Animal performance enhancement: homeostatic animals perform (= produce) better, as resources are channeled for production instead of coping with stressors**

- **Improving farmers profitability**

  (fertility, growth rate, milk production etc.)

Environmental enrichment in dairy goats

Rational:

- **Goats are very rustic(rural) & herd animals, live in groups mostly in pasture. Relocation to intensive framing may result in:**

  - **Husbandry related stress** [Sevi et al.(2009); Grandin et al.(2015)]
  - **Lack of resources, competition between individuals and aggressiveness** [Sevi et al.(2009); Barroso et al.(2020)]
  - **Lack of enrichment (boredom) and aggressiveness** [Wemelsfelder et al.(1986)]
  - **Tampered physiological, immunological and productivity parameters** [Kannan et al.(2000); Miranda-de la Lama et al.(2013); Nwe et al.(1996); Fazio et al.(2015)]
  - **Environmental enrichment can alleviate husbandry related stress** [Aschwanden et al.(2009); Mandel et al.(2013)]

Experimental design:

Milking

Dry

N=12

N=12

Adaptation period

28 days

Control group

Enriched group

10 days

Classic physiological & hematological parameters:

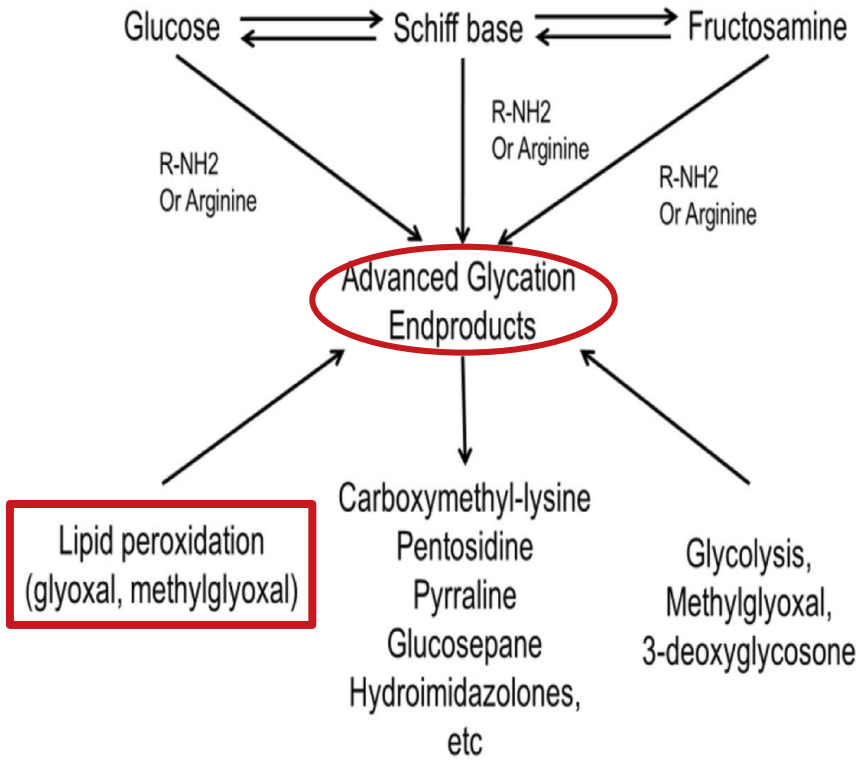
- **Complete Blood count (CBC)**
  - **Within normal reference range and with no significant changes following the environmental enrichment!**

- **Blood Biochemistry**

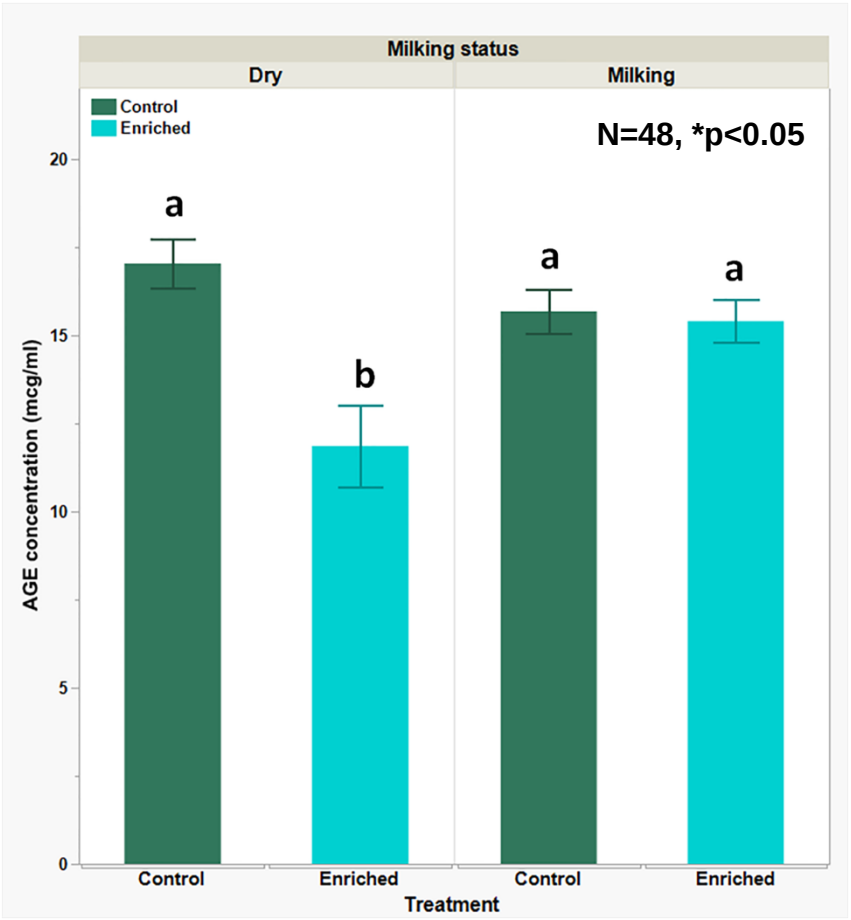
Parameter	Dry Goats Mean ± SEM		Milking Goats Mean ± SEM		*P*-Value
	Control	Enriched	Control	Enriched	
Albumin (g/dL)	3.30 ± 0.13 ^{ab}	3.56 ± 0.16 ^{ab}	3.70 ± 0.19 ^{a}	3.10 ± 0.10 ^{b}	* 0.0325
ALT (U/L)	16.50 ± 0.58 ^{a}	14.34 ± 0.72 ^{ab}	13.12 ± 0.33 ^{b}	15.51 ± 0.44 ^{ab}	* 0.0030
Sodium (mmol/L)	146.36 ± 0.60 ^{b}	148.5 ± 0.47 ^{a}	149.75 ± 0.55 ^{a}	146.4 ± 0.46 ^{b}	* <0.0001
Chloride (mmol/L)	104.47 ± 0.54 ^{b}	107.13 ± 0.93 ^{a}	107.24 ± 0.97 ^{a}	103.35 ± 0.66 ^{b}	* <0.0001

Oxidative metabolites status:

- **Reduction in serum advanced glycation end products (AGE) only in dry goats group post enrichment – indication of reduction in oxidative stress in this group**

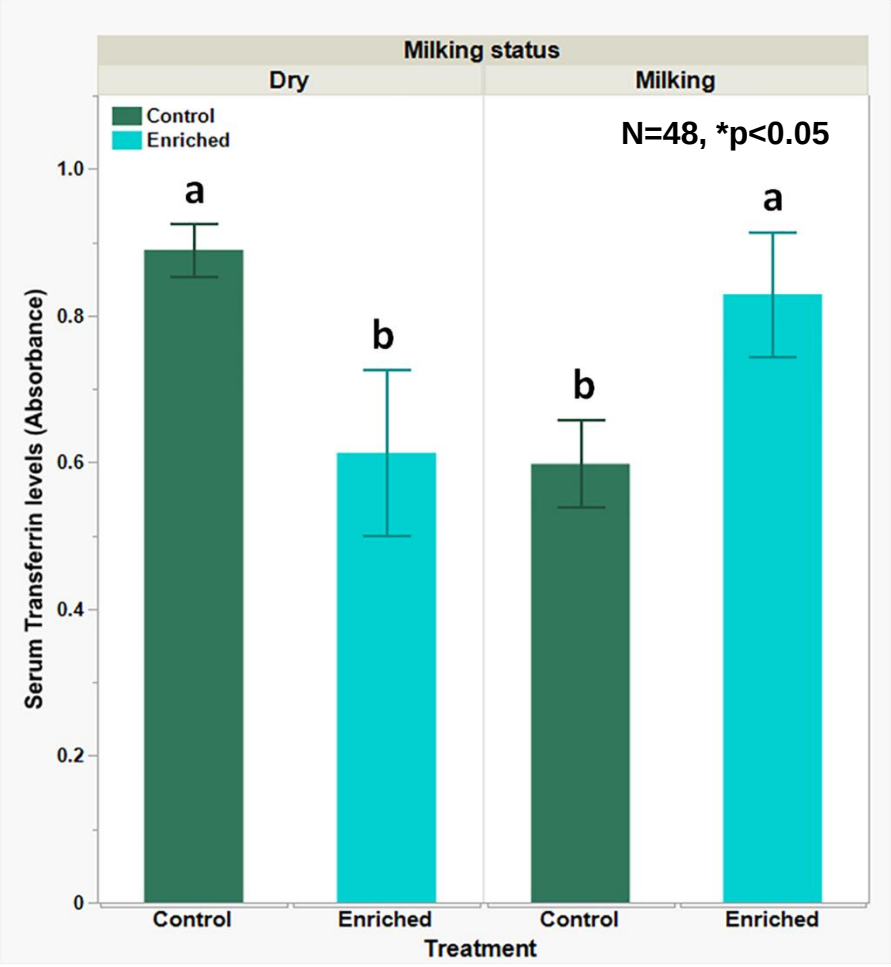


Chen et al., Nutrition & Metabolism 15: 72, 2018



Immune related anti-oxidant: Transferrin

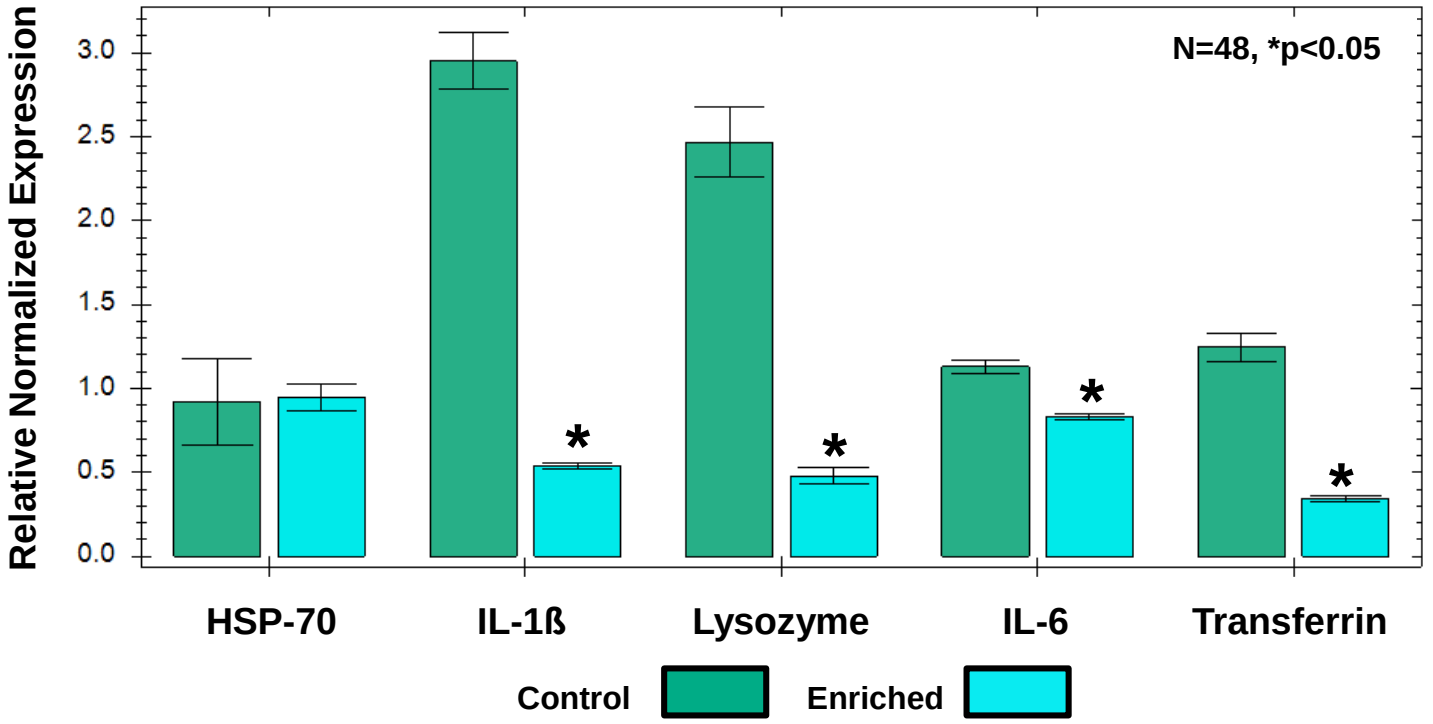
- **Reduction in serum Transferrin levels in dry enriched group – indication of reduction of oxidative stress in this group and the <u>opposite</u> in milking enriched group!**



Immune (stress related) gene expression In PBLs

Dry goats:

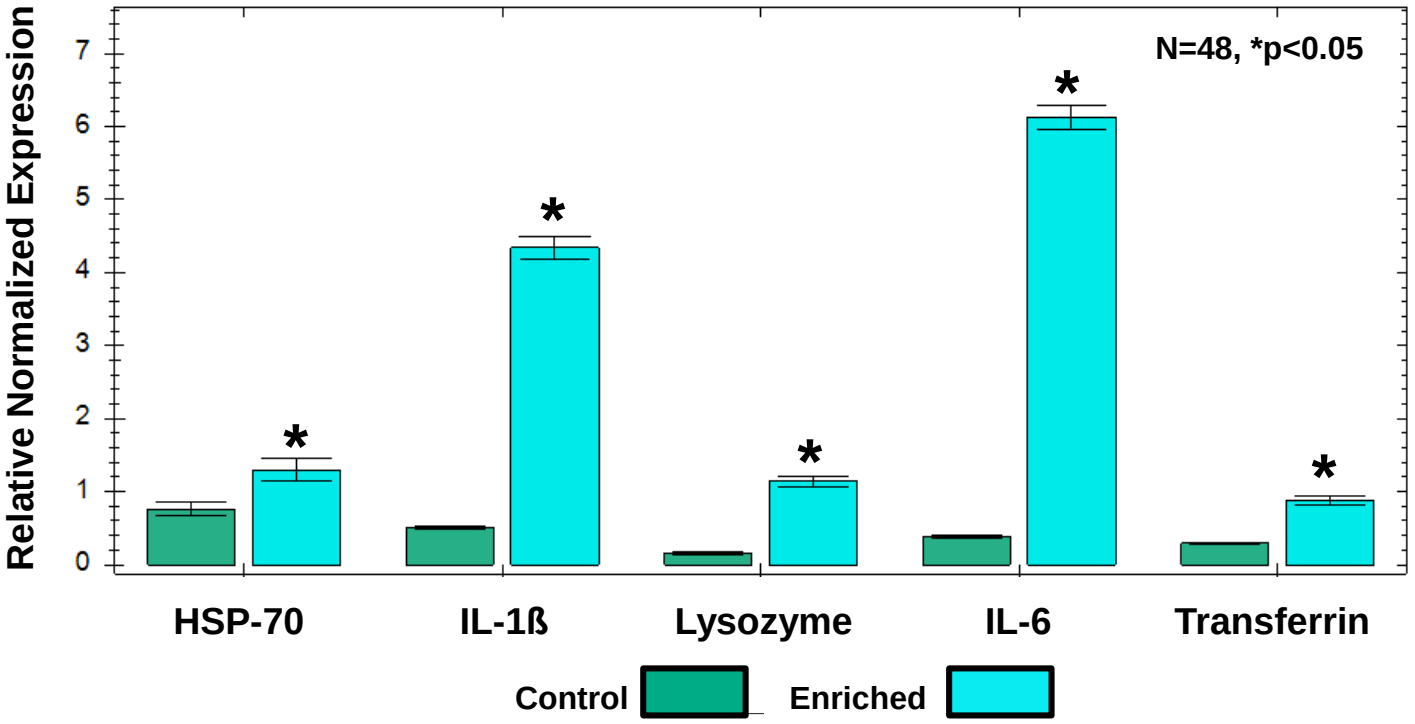
- No change in HSP-70: multi-specie cellular marker
- Decline in pro-inflammatory cytokines gene expression
- Decline in immune related anti-oxidants (Lysozyme&Transferrin) gene expression
- Decline in 3/4 genes of interest in dry enriched group – indication of reduction in stress in this group.



Immune (stress related) gene expression In PBLs

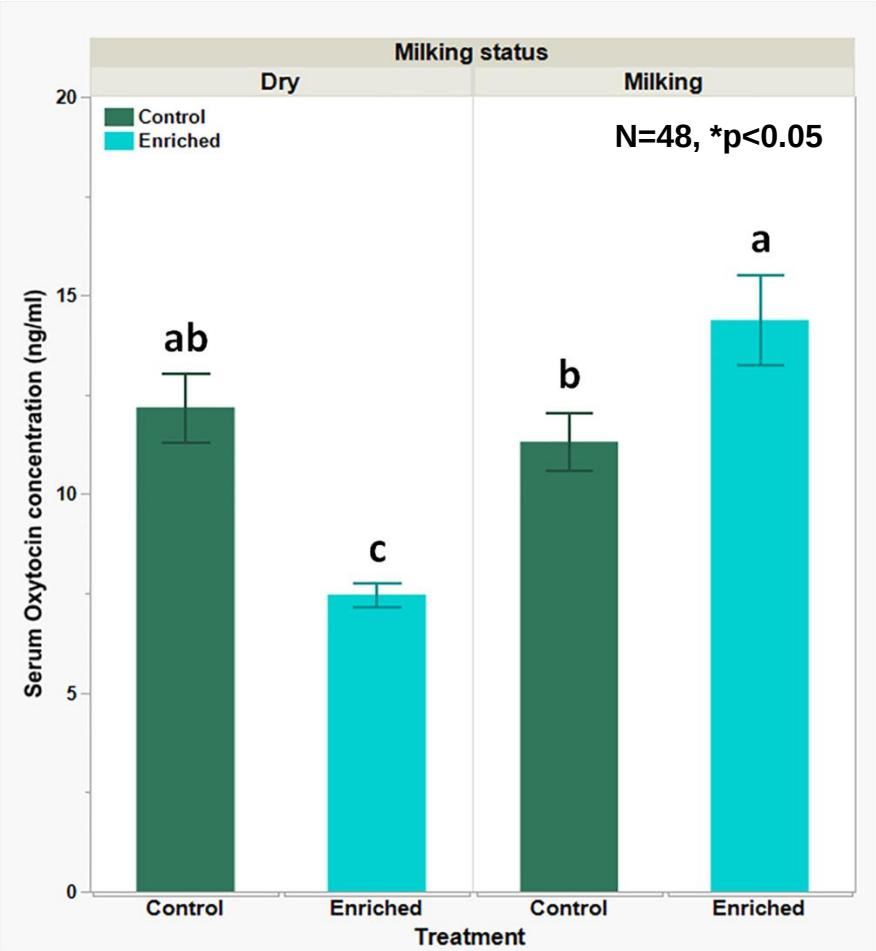
Milking goats:

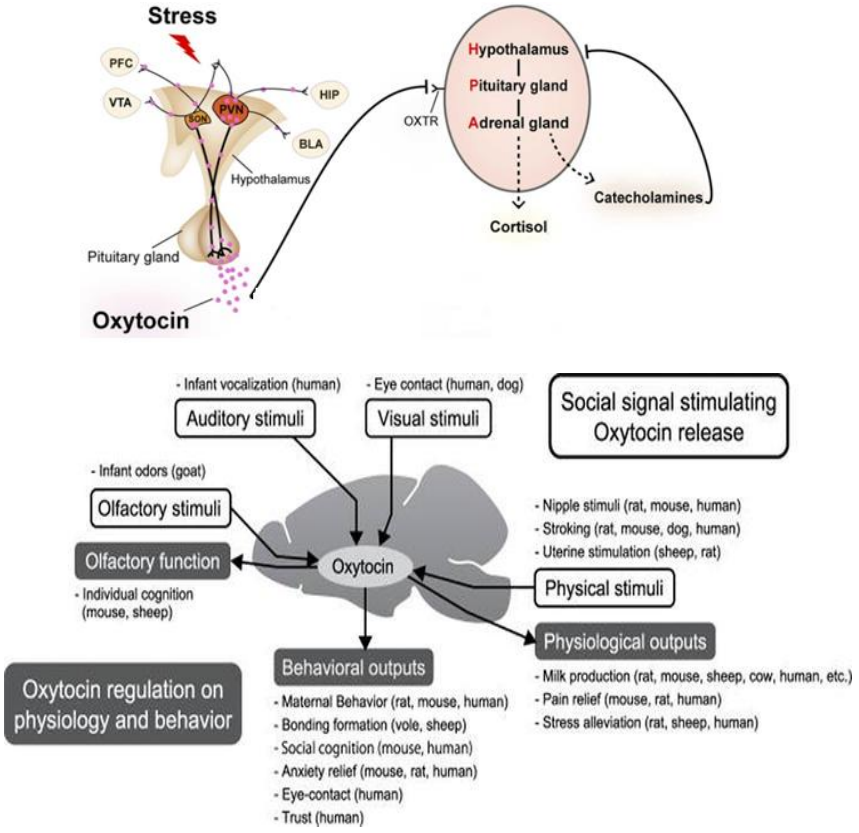
- Incline in HSP-70: multi-specie cellular marker
- Incline in pro-inflammatory cytokines gene expression
- Incline in immune related anti-oxidants (Lysozyme&Transferrin) gene expression
- Incline in 4/4 genes of interest in milking enriched group – indication of elevation in stress in this group



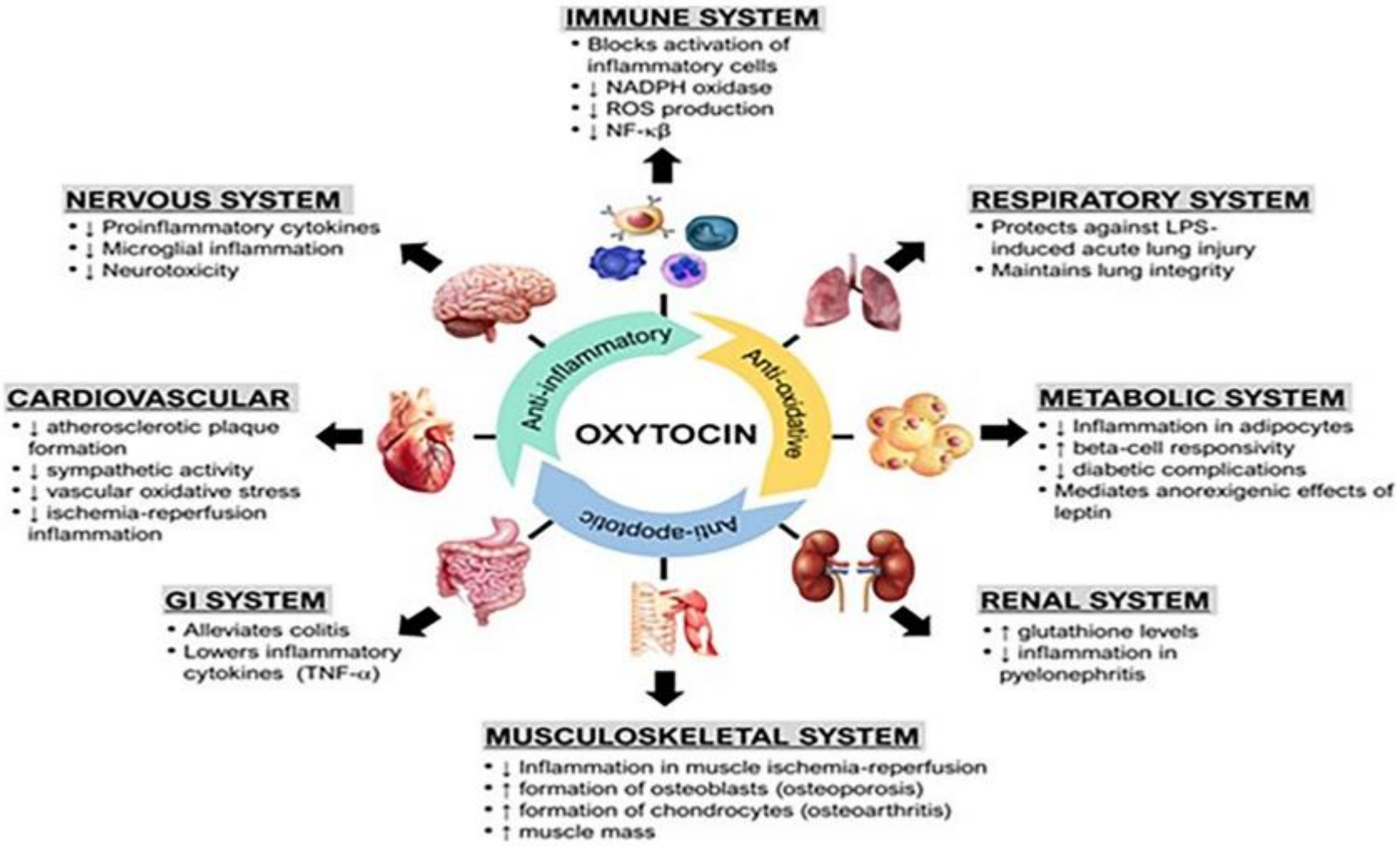
Anti-stress hormone – Oxytocin:

- **Reduction in serum Oxytocin levels in dry enriched group – indication of reduction of stress in this group and the <u>opposite</u> in milking enriched group**





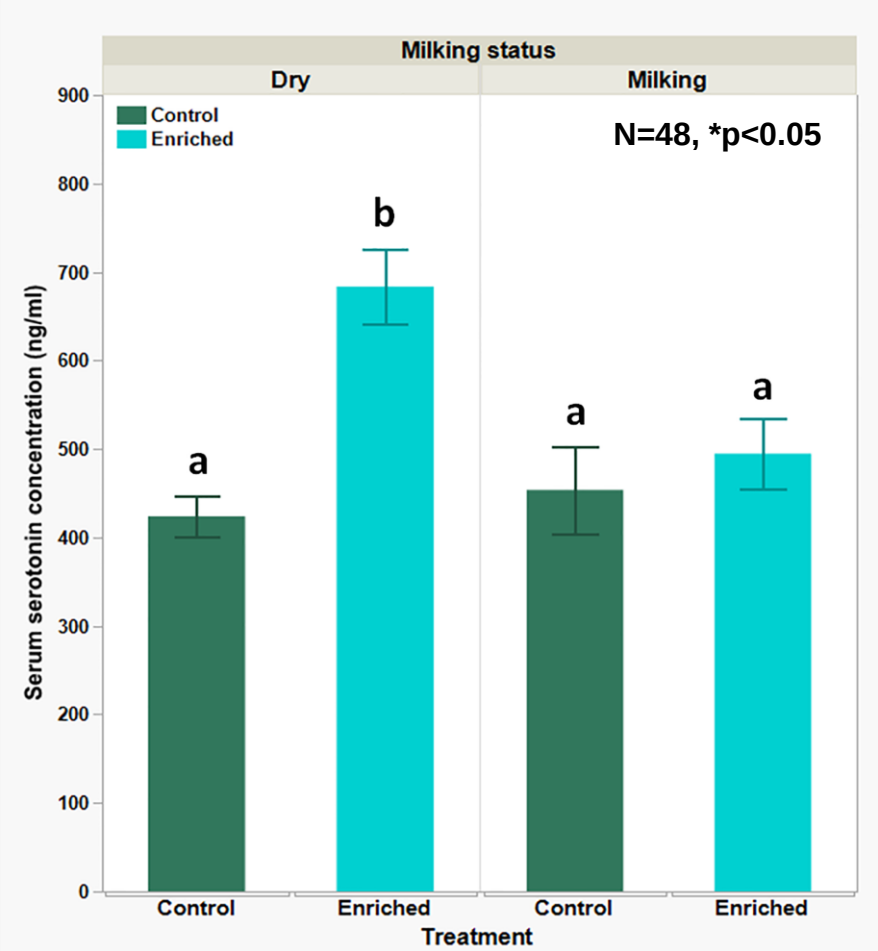
Oxytocin effects:

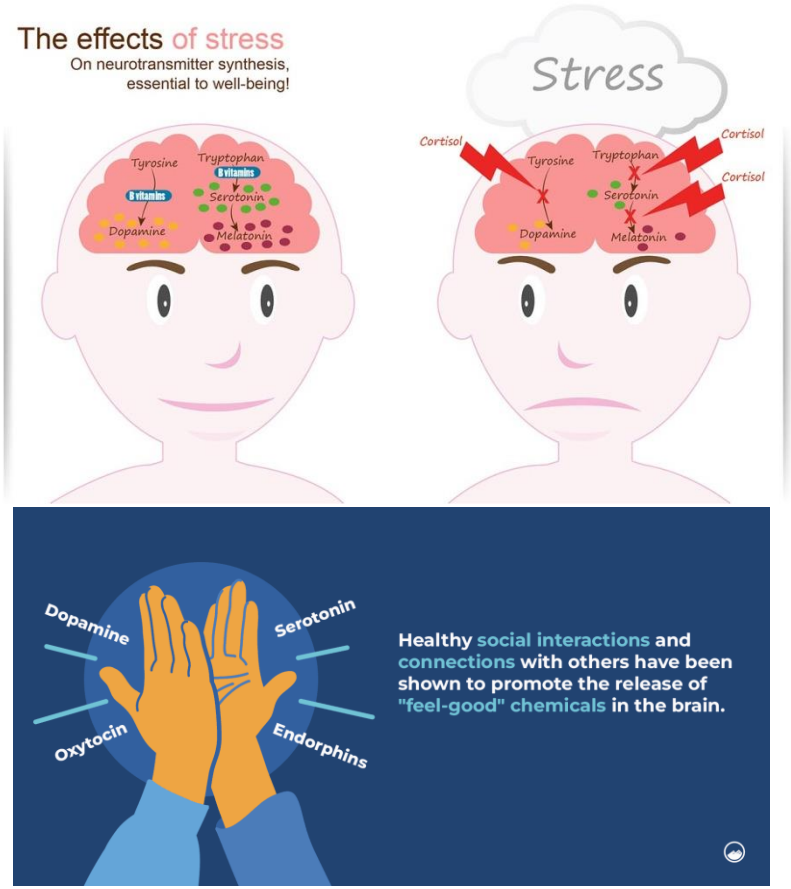


Mehdi et al., Frontiers in immunology 13, 2022

Anti-stress hormone – Serotonin:

- **Elevation in serum Serotonin levels in dry enriched group – indication of reduction of stress in this group, while no change in milking enriched group**





conclusions:

- **Stress involves biochemical and physiological responses of multiple systems: nervous, endocrine and immune.**
- **The use of physiological, biochemical and immunological markers, allows early detection of stressors in different husbandry practices.**
- **Environmental enrichment (stages & brushes), affected the goats in an opposite manner (depending on their physiological statuses); alleviate stress in the dry goats, while induces stress in the milking goats.**
- **It is recommended to continue and research for other means to alleviate stress in farm animals, using the described methodology and while keeping in mind that animals in different physiological statuses, can react differently. Most importantly: "Primum non nocere"**

Additional reading:

biology

MDPI

Article

The Effect of Environmental Enrichment on Selected Physiological and Immunological Stress-Related Markers in Dairy Goats

Yossi Wein *, Ofri Vaidenfeld, Chris Sabastian, Enav Bar Shira, Sameer J. Mabjeesh *, Haim Tagari and Aharon Friedman

Department of Animal Sciences, R.H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, P.O. Box 12, Rehovot 7610001, Israel

* Correspondence: yosi.wein@mail.huji.ac.il (Y.W.); sameer.mabjeesh@mail.huji.ac.il (S.J.M.)

Biology 2024, Volume 13, Issue 11, 859


Thank you for your attention!
Questions?
Lab partners and research collaborators:
Prof. Sameer Mabjeesh
Dr. Enav Bar-Shira
Chris Sabastian
Ofri Vaidenfeld