SAPIENZA
UNIVERSITÀ DI ROMA

CONGRESSO
ATMOSFERE IPERBARICHE
FATTORI DI RISCHIO E MODELLI
DI PREVENZIONE

INAIL
ISTITUTO NAZIONALE PER L'ASSICURAZIONE
CONTRO GLI INFORTUNI SUL LAVORO

ESPOSIZIONE AD ATMOSFERE IPERBARICHE: ANALISI DEL PROFILO INFIAMMATORIO

Dipartimento di Scienze e Biotecnologie Medico-Chirurgiche – Università La Sapienza

rita.businaro@uniroma1.it

14 OTTOBRE 2019

ESPOSIZIONE A ELEVATA pO_2

- accentua lo stress ossidativo
- Stimola infiammazione
- Risposte patofisiologiche in acuto
- Cambiamenti persistenti nel tempo in seguito ad esposizione cronica?
- Fattori di rischio per lo sviluppo d malattie cronico-degenerative?
- Possibili strategie di prevenzione?

rita.businaro@uniroma1.it

Physiol Genomics 45: 965–972, 2013.
First published August 20, 2013; doi:10.1152/physiolgenomics.00164.2012.

Acute and potentially persistent effects of scuba diving on the blood transcriptome of experienced divers

Ingrid Eftedal,[1] Marko Ljubkovic,[2] Arnar Flatberg,[3] Arve Jørgensen,[1] Alf O. Brubakk,[1] and Zeljko Dujic[2]

Diving and Hyperbaric Medicine Volume 47 No. 1 March 2017 9

A comparative evaluation of two decompression procedures for technical diving using inflammatory responses: compartmental versus ratio deco

Enzo Spisni, Claudio Marabotti, Luigia De Fazio, Maria Chiara Valerii, Elena Cavazza, Stefano Brambilla, Klarida Hoxha, Antonio L'Abbate and Pasquale Longobardi

FREE RADICAL RESEARCH
2019, VOL. 53, NO. 5, 522–534
https://doi.org/10.1080/10715762.2019.1612890

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ORIGINAL ARTICLE

Check for updates

Effect of hyperoxia on the immune status of oxygen divers and endurance athletes

Frauke Tillmans[a], Roshanak Sharghi[b]*, Tatjana Noy[a]*, Wataru Kähler[a], Sebastian Klapa[a], Simon Sartisohn[a], Susanne Sebens[b]† and Andreas Koch[a]†

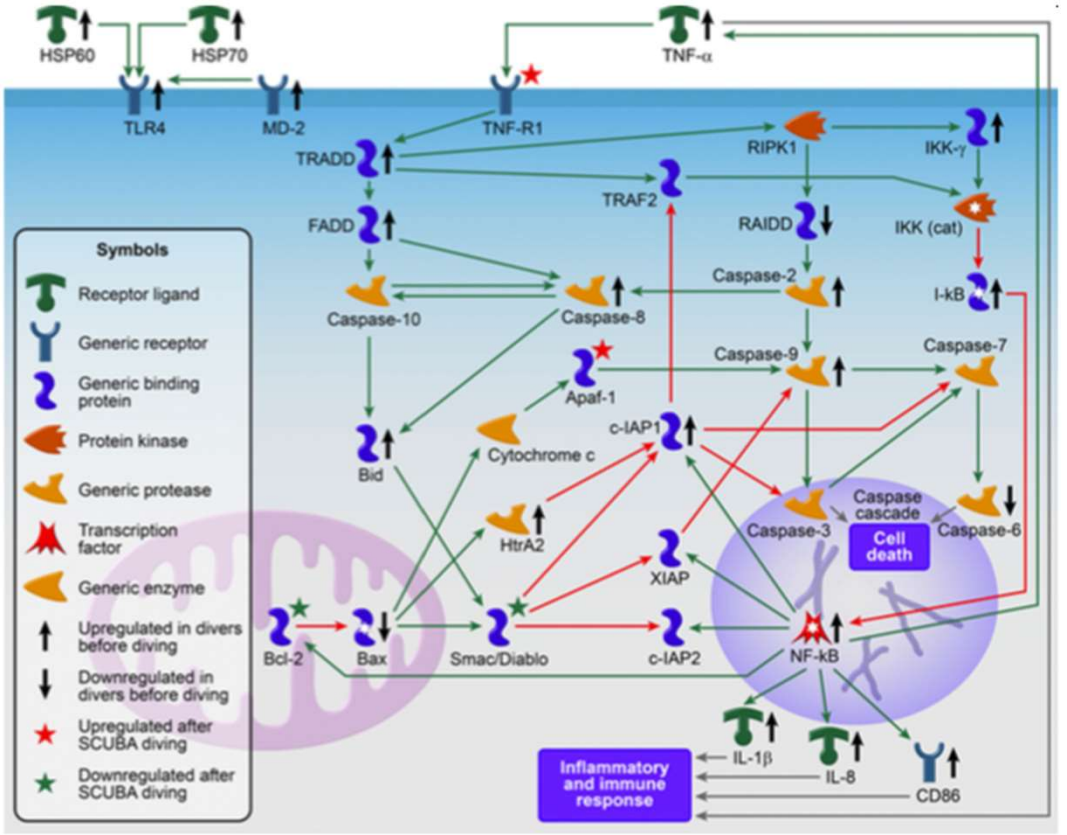


Fig. 2. Acute and persistent effects of scuba diving on blood gene expression in the tumor necrosis factor receptor superfamily member 1A (TNFR1) and toll-like receptor 4 (TLR4)-mediated signaling pathways. Vertical arrows adjacent to protein symbols mark differential expression in the divers' predive stationary transcriptomes. Stars mark acute changes in expression after scuba diving. The map is based on MetaCore GeneGo pathway analysis of microarray data.

Eftedal et al.Physiol Genomics. 2013;45::965-72.

rita.businaro@uniroma1.it

Table 2. *Selected blood cell associations for genes that were down- and upregulated after scuba diving*

Cell Types	Genes (*n*) in Data	Genes (*n*) in Reference	*P* Value
Downregulation			
Activated T cells, CD8+ CD45.1+	65	387	3.514e-18
NK cells, NK1.1+ TCRb− Ly49H+	61	370	1.747e-16
NK cells, NK1.1+ CD3− Ly49C/I+	62	385	2.913e-16
Upregulation			
Neutrophils, CD11b+ Ly6-G+	54	418	5.072e-20
Macrophages, CD45+ F4/80+ CD11b+	38	402	6.142e-9
Classical monocytes HMCII−, CD115+ B220− CD43+ Ly6C+	36	408	1.737e-7

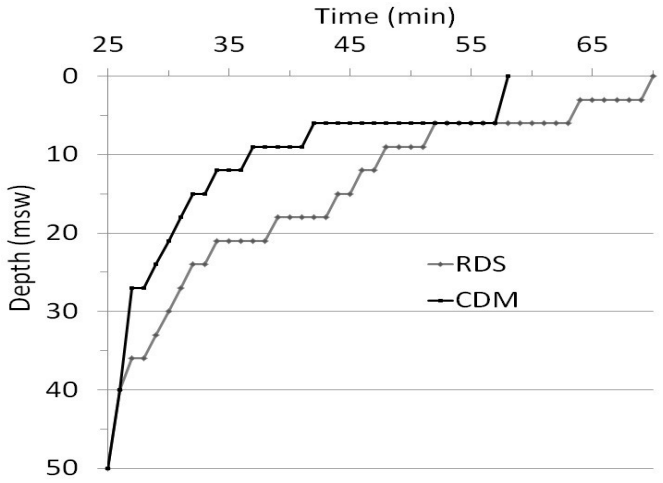
Table 3. *The most significant biological pathway associations for the divers' blood transcriptome changes after scuba diving*

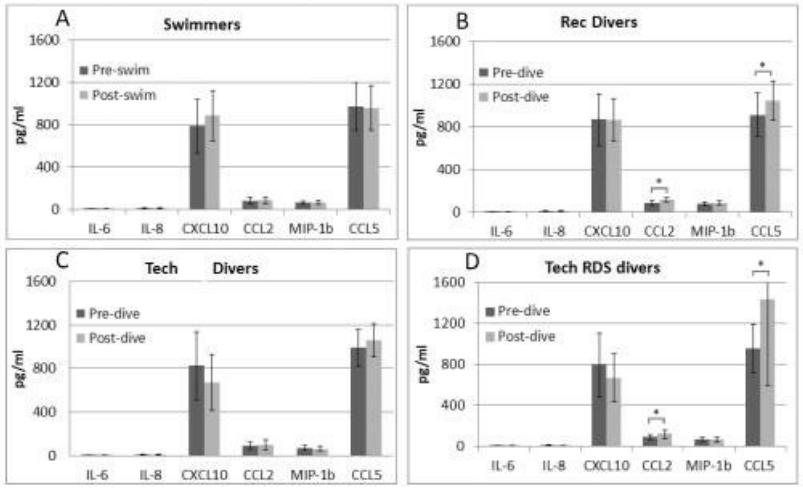
Pathway	Genes (*n*) in Data	Genes (*n*) in Reference	*P* Value
Apoptosis and survival: granzyme B signaling	11	32	3.110e-8
Development: transcription regulation of granulocyte development	9	32	3.901e-6
Immune response: T cell receptor signaling pathway	11	53	8.393e-6

Eftedal et al.Physiol Genomics. 2013;45::965-72

rita.businaro@uniroma1.it

La variazione del **profilo infiammatorio** sistemico rappresenta un potenziale **biomarcatore** della risposta dell'organismo allo stress iperbarico ed è stata proposta come parametro per il monitoraggio della qualità della decompressione e la stima del **rischio iperbarico** nella pratica subacquea *[Spisni et al., 2017]*.





Confronto tra due procedure di decompressione comunemente adottate dai subacquei tecnici: modello di decompressione compartimentale, CDM rispetto alla "strategia di decompressione del rapporto" RDS e analisi dei cambiamenti nei profili infiammatori circolanti del sub causati dalla decompressione da una singola immersione.

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UNIVERSITÀ DI ROMA

rita.businaro@uniroma1.it

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Blood Gene Expression and Vascular Function Biomarkers in Professional Saturation Diving

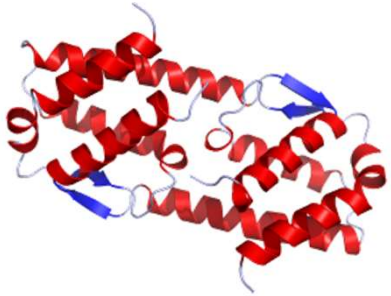
Fatima Z. Kiboub[1,2], Andreas Møllerløkken[3], Astrid Hjelde[1], Arnar Flatberg[4], Øyvind Loennechen[2] and Ingrid Eftedal[1,5]*

TABLE 3 | Plasma biomarker levels pre- and post-saturation with and without antioxidant vitamin C and E supplements.

	Divers with vitamins (n = 13)		Divers without vitamins (n = 7)	
	Pre-saturation	**Post-saturation**	**Pre-saturation**	**Post-saturation**
CRP (mg/l)	1.50 (0.12–6.74)	0.98 (0.13–4.60)	0.55 (0.15–0.97)	1.27 (0.16–4.40)
IL-6 (ng/ml)	1.02 (0.31–3.67)	1.11 (0.23–4.46)	0.89 (0.52–1.35)	1.51 (0.20–7.07)
ICAM-1 (pg/ml)	206.77 (131.81–365.71)	220.81 (146.25–403.38)	157.38 (71.53–200.91)	164.68 (79.29–189.59)
Fibrinogen (g/l)	2.86 (2.30–3.60)	2.96 (2.30–4.20)	2.57 (1.90–3.50)	2.94 (2.30–3.40)
PAI-1 (ng/ml)	8.27 (0.58–25.80)	10.83 (2.50–47.79)	6.43 (1.76–12.48)	4.65 (1.76–9.89)

Le attività svolte in **ambienti iperbarici** sono associate a **risposte infiammatorie e stress ossidativo.**

Le **citochine** sono importanti mediatori rilasciati dalle cellule, appartenenti principalmente al sistema immunitario.
A seconda della citochina considerata, rispondono con cinetiche diverse a stimoli esogeni e endogeni e sono influenzate da fattori epigenetici, compreso il cibo.



RELAZIONE TRA ALIMENTAZIONE E RESILIENZA INDIVIDUALE AGLI STIMOLI AMBIENTALI

rita.businaro@uniroma1.it

Sono stati presi in considerazione i livelli di **citochine pro e anti-infiammatorie** presenti nel plasma e prodotte da cellule mononucleate del sangue periferico. I campioni di sangue sono stati ottenuti prima, 30 e 90 minuti dopo l'immersione. Questi dati sono stati correlati alla composizione corporea determinata dalla pletismografia aerea.

ANALISI DELLA COMPOSIZIONE CORPOREA

Lo studio pilota è stato eseguito su un campione costituito da 5M e 1F (età 54,3±7,6; BMI 29±4,6 kg/m2). I valori sono compatibili con il grado di eccesso ponderale.

	DENSITA' CORPOREA (g/cm^3)	MASSA MAGRA % (BODPOD® eq. SIRI)	MASSA GRASSA % (BODPOD® eq. SIRI)
Media	1,02247	65,78	34,22
Deviazione std.	0,01604	7,55	7,55
Minimo	1,00600	57,95	23,55
Massimo	1,04530	76,45	42,05

	Angolo di Fase (50 kHz)	Z_{250}/Z_5	Ht^2/Z_{50}
Media	6,18	0,77	70,78
Deviazione std.	0,57	0,02	15,69
Minimo	5,60	0,74	42,17
Massimo	6,80	0,79	84,94

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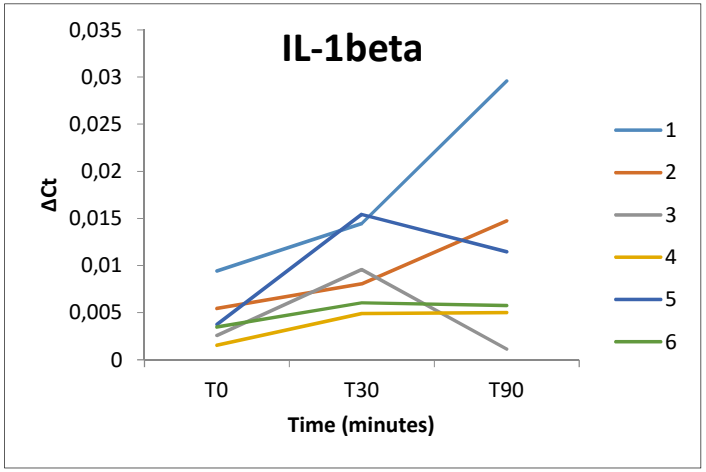
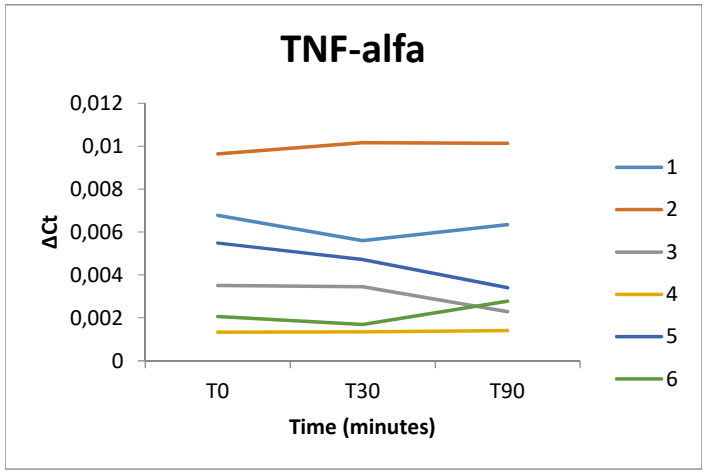
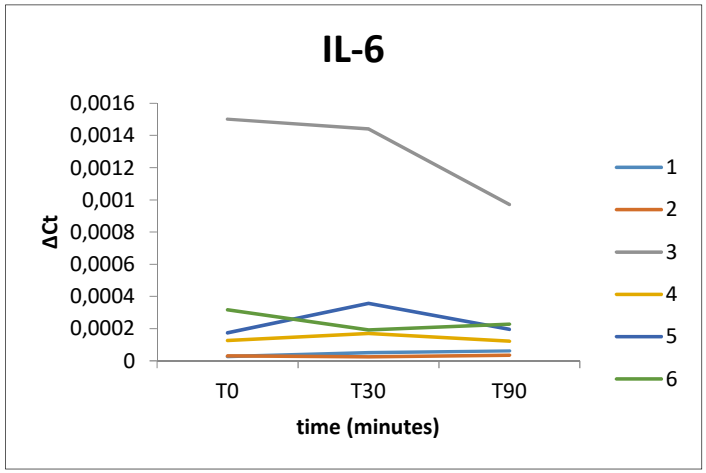
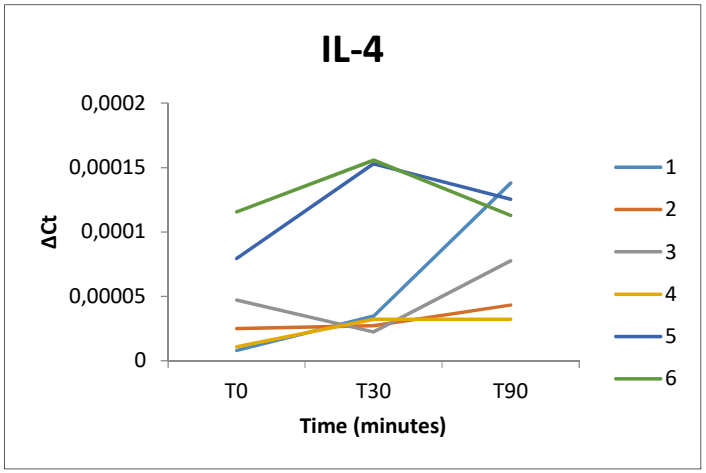
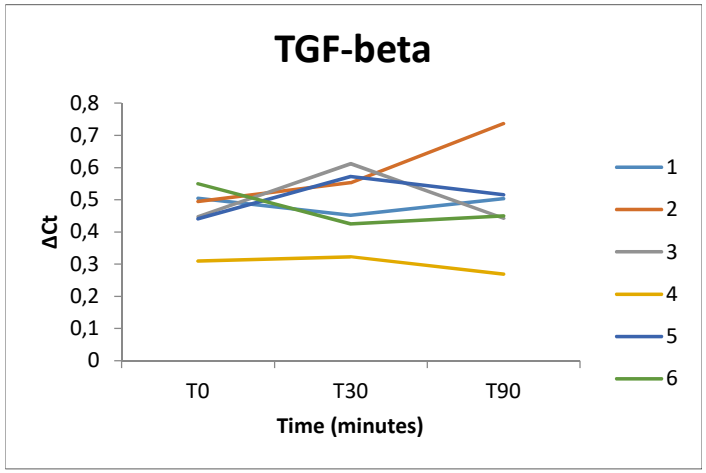
TEST CAMERA IPERBARICA Espressione degli mRNA delle citochine pro e anti-infiammatorie

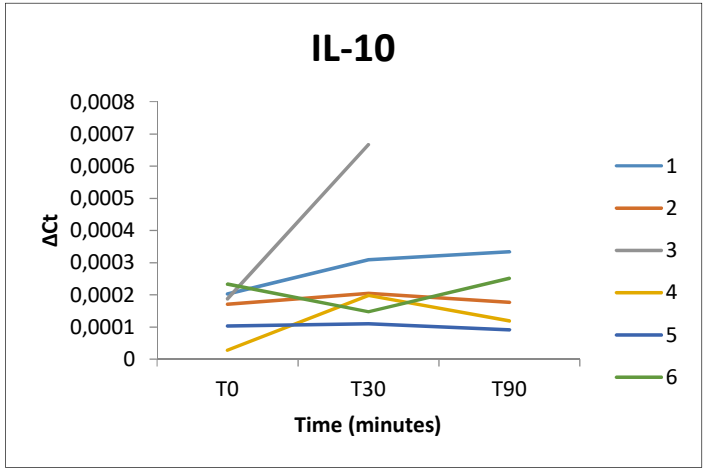












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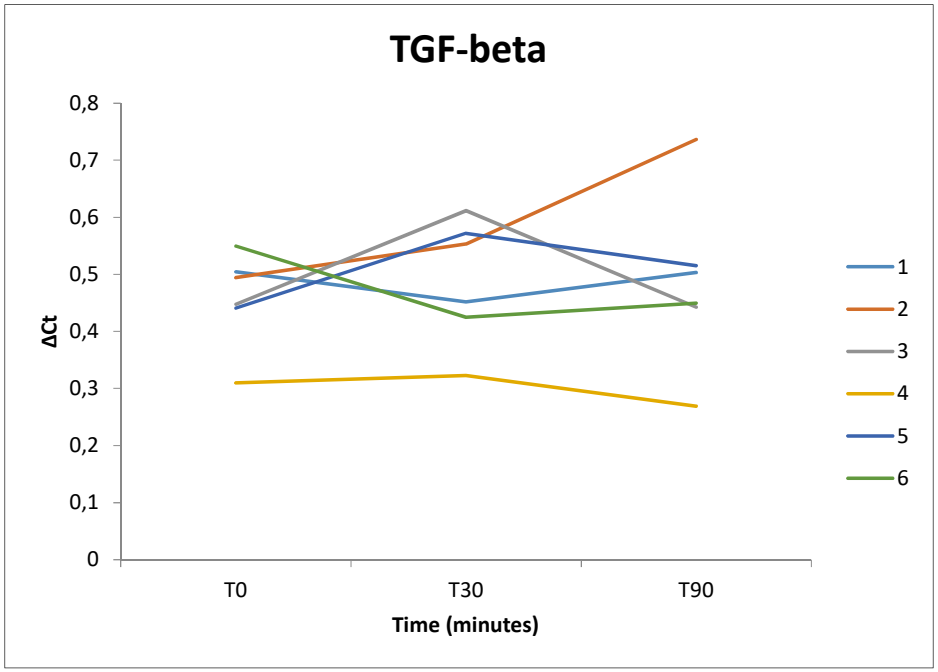
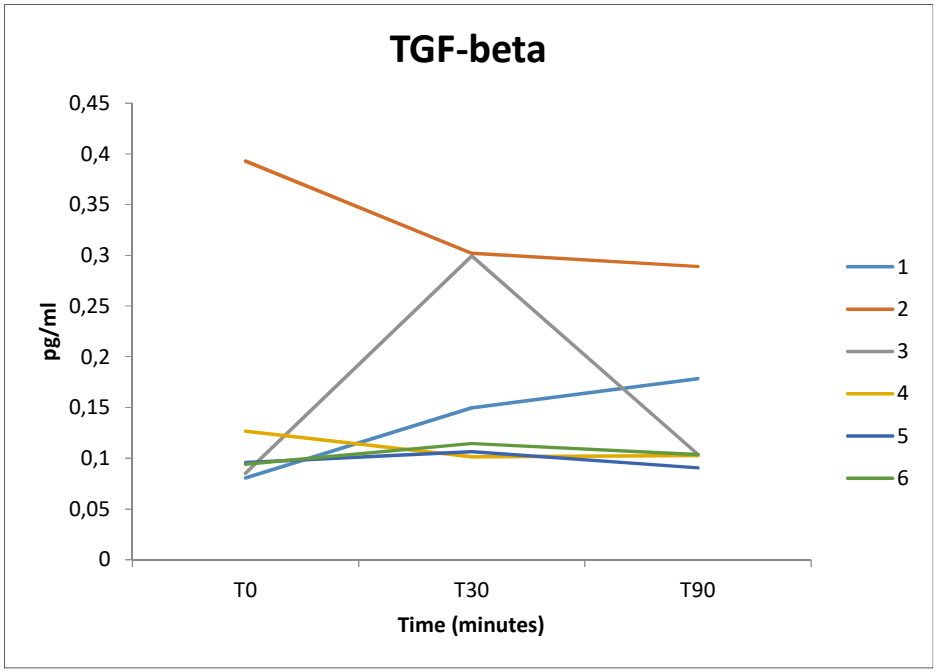
CORRELAZIONE TRA ANALISI DELL'mRNA e DELL'ESPRESSIONE PROTEICA





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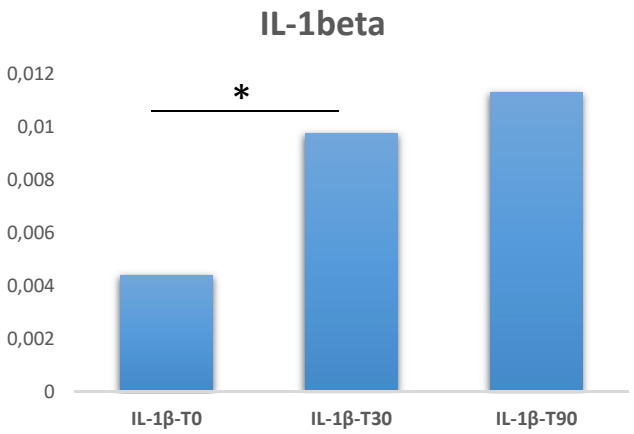
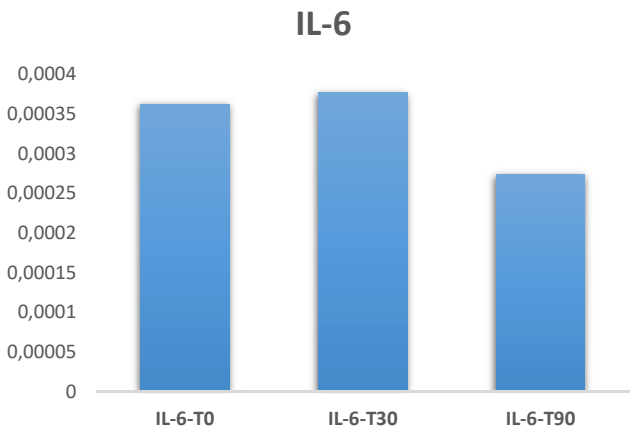
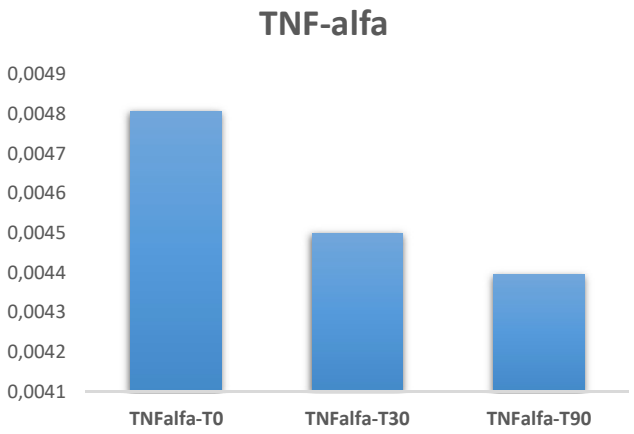
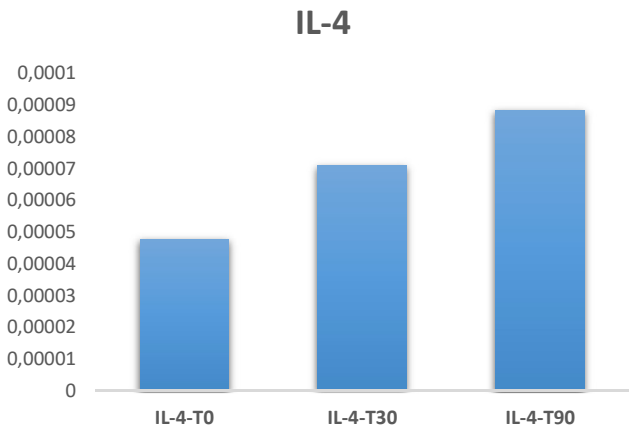
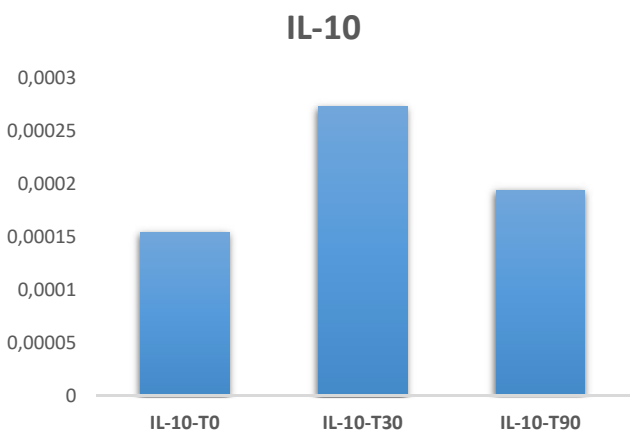
CAMERA IPERBARICA

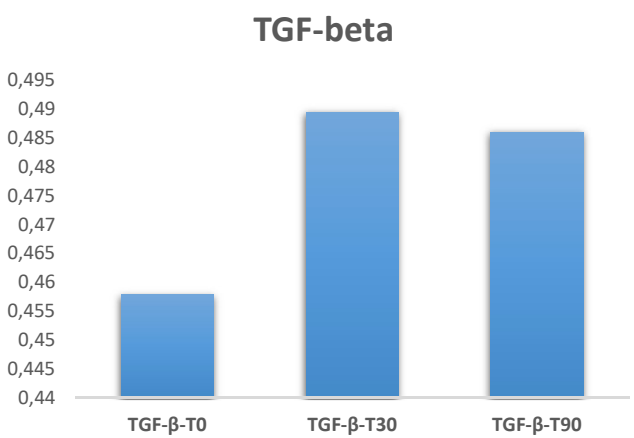












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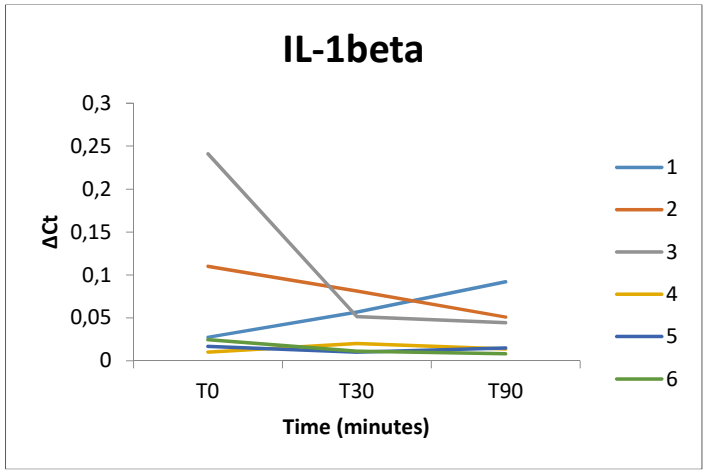
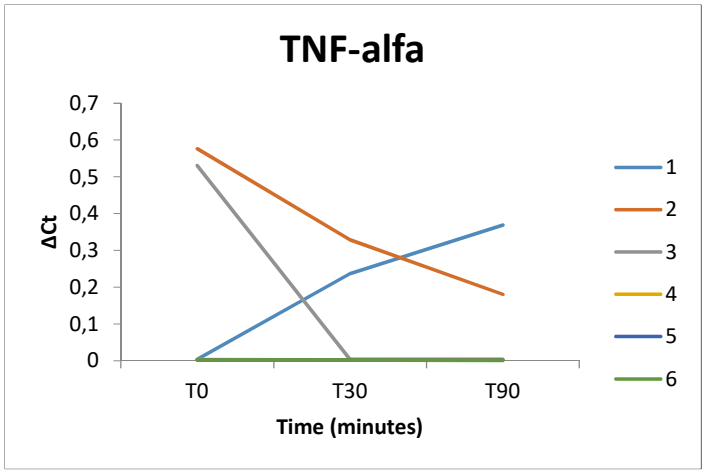
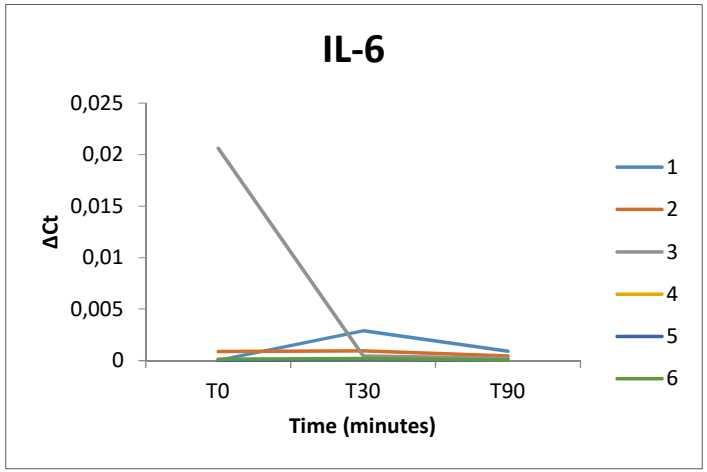
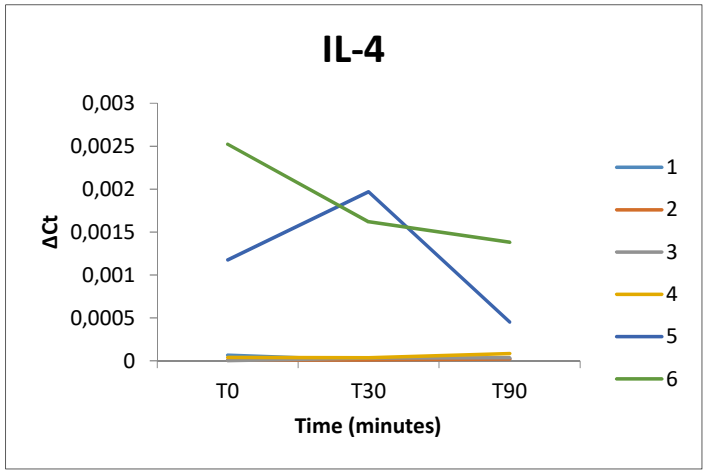
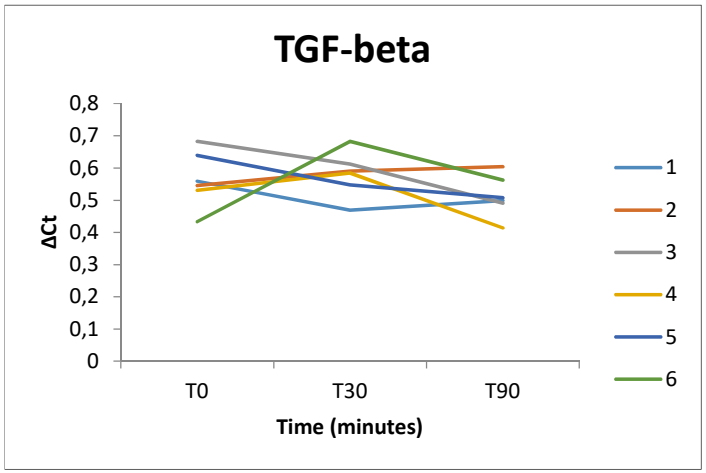
TEST LAGO DI BRACCIANO Espressione degli mRNA delle citochine pro e anti-infiammatorie

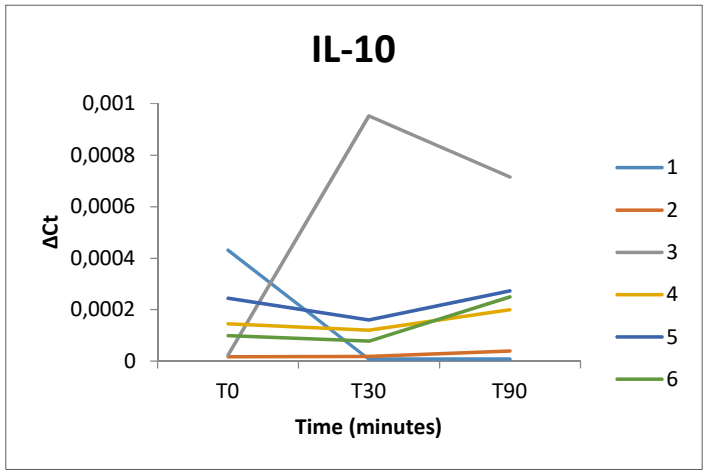












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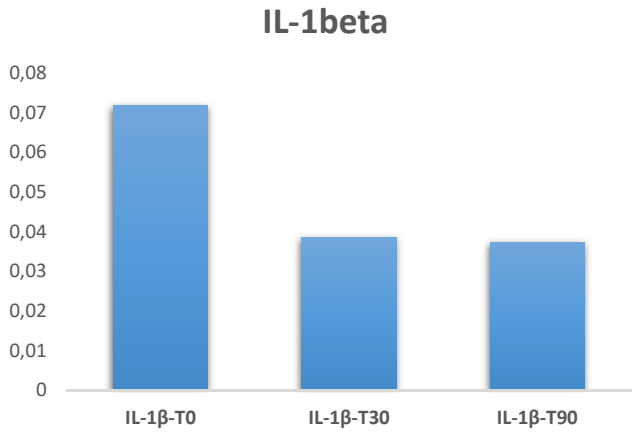
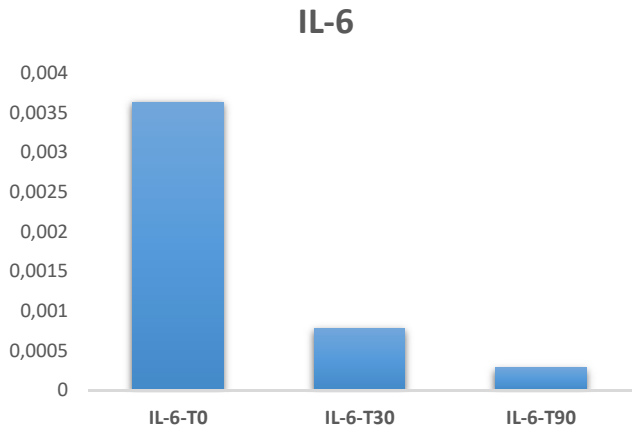
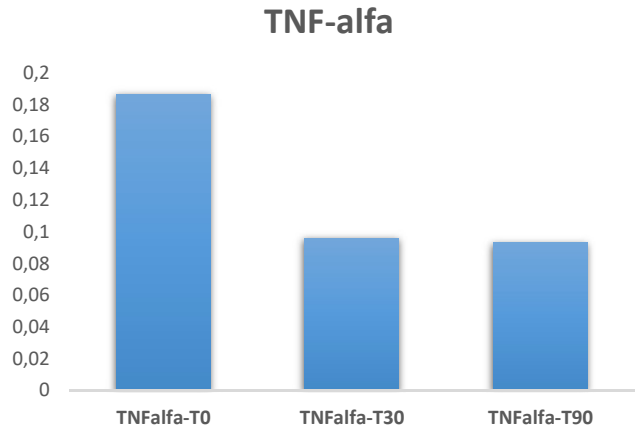
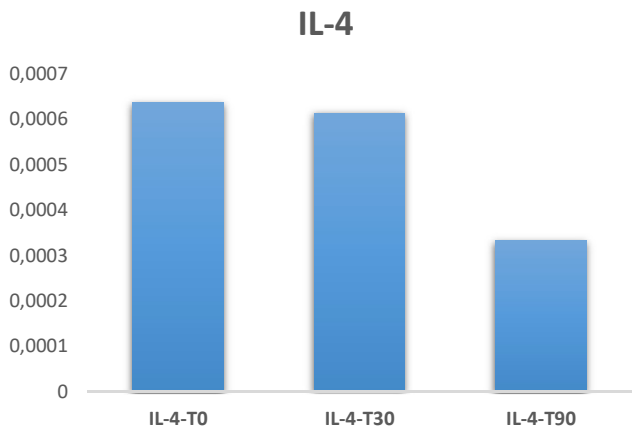
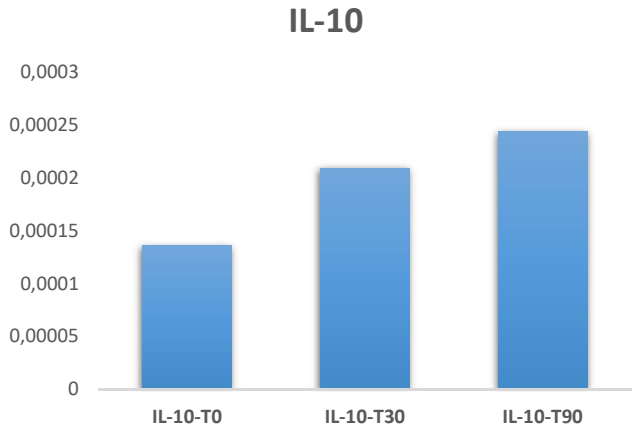
LAGO DI BRACCIANO

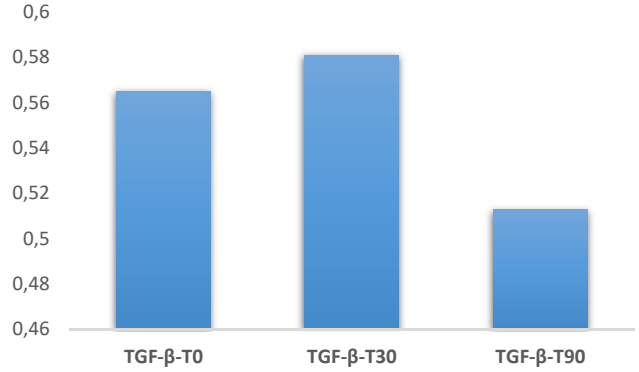












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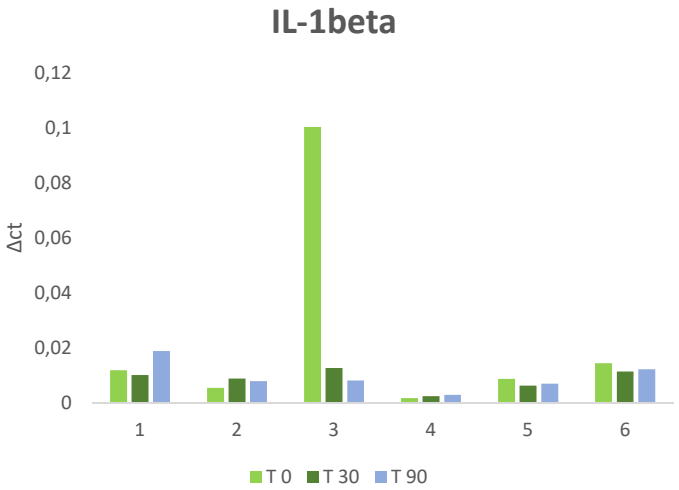
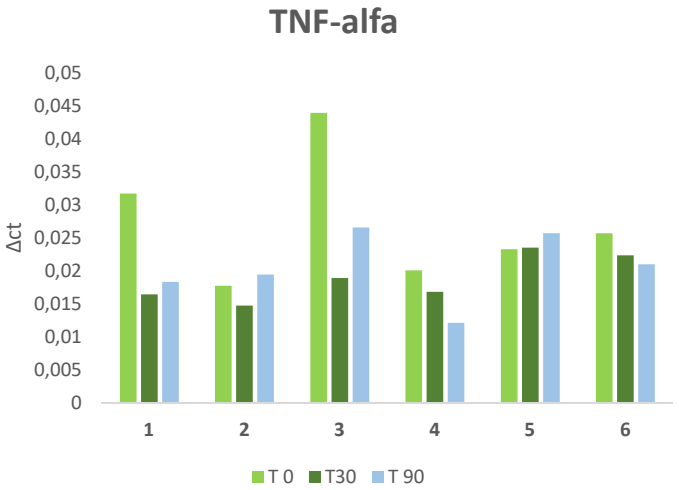
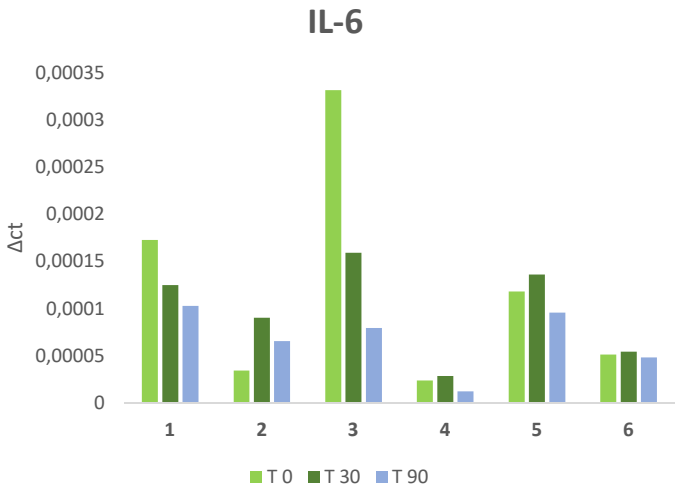
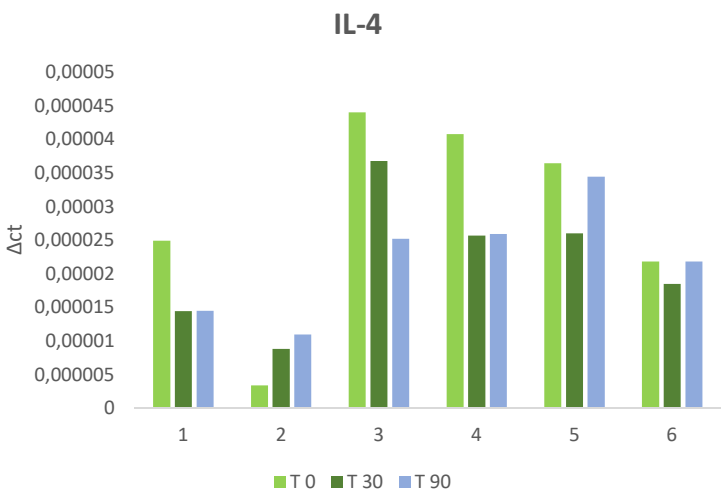
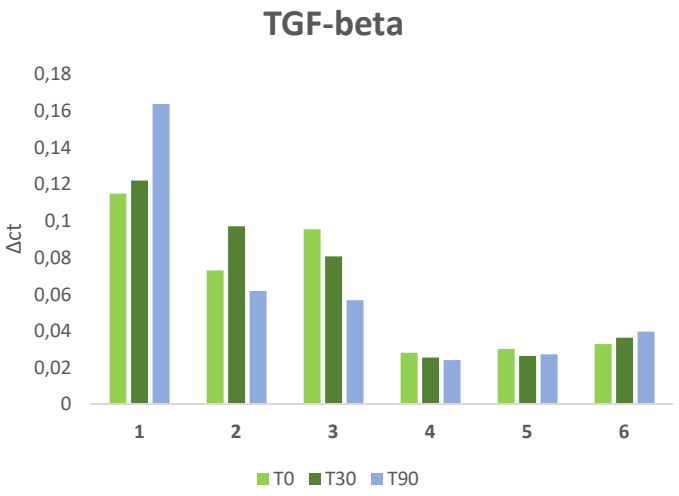
TEST GALLIPOLI Espressione degli mRNA delle citochine pro e anti-infiammatorie

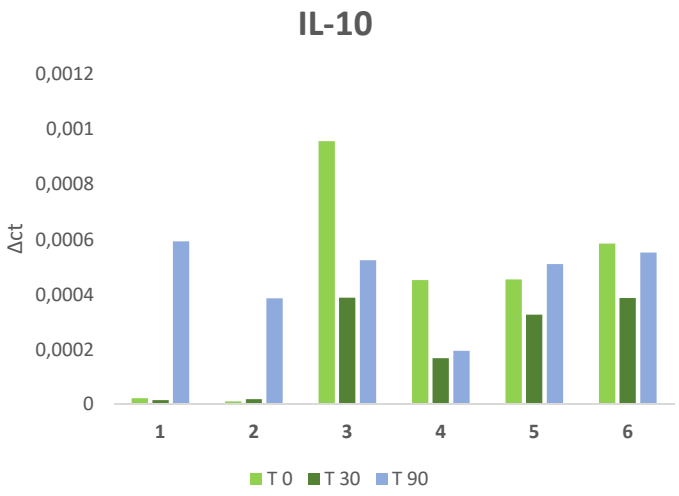












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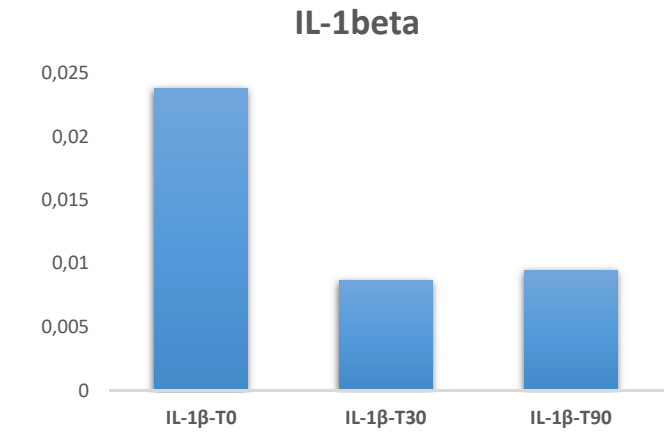
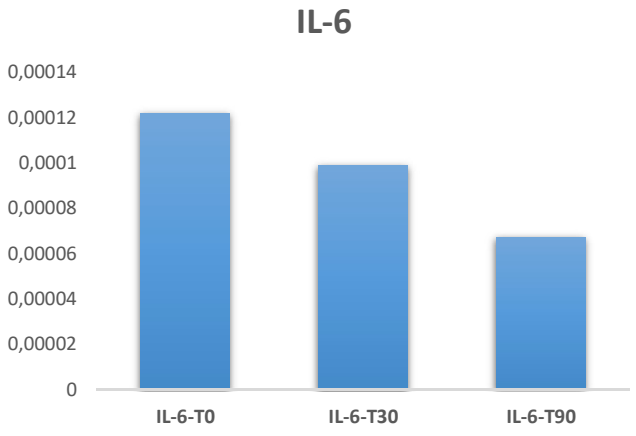
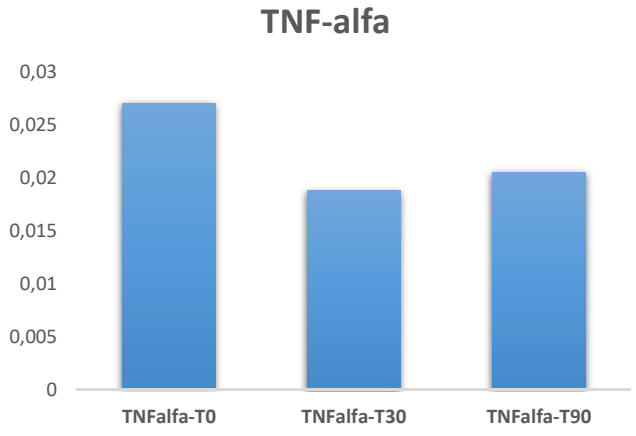
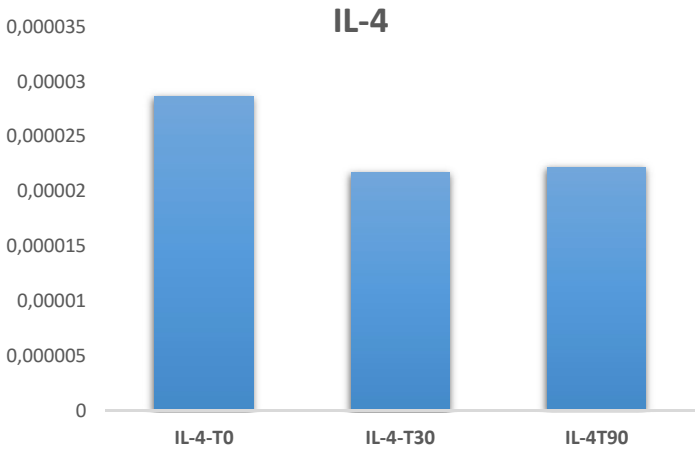
rita.businaro@uniroma1.it

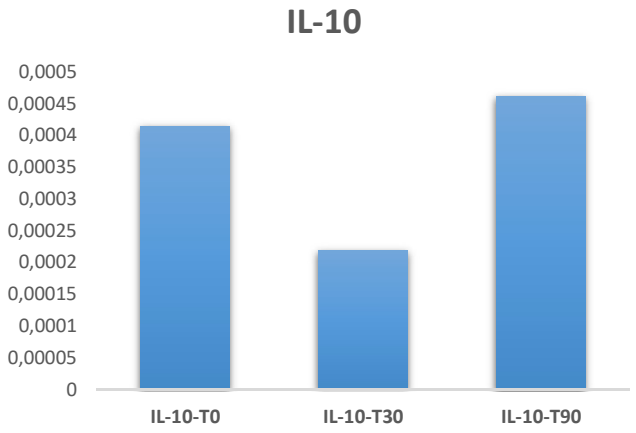
TEST GALLIPOLI

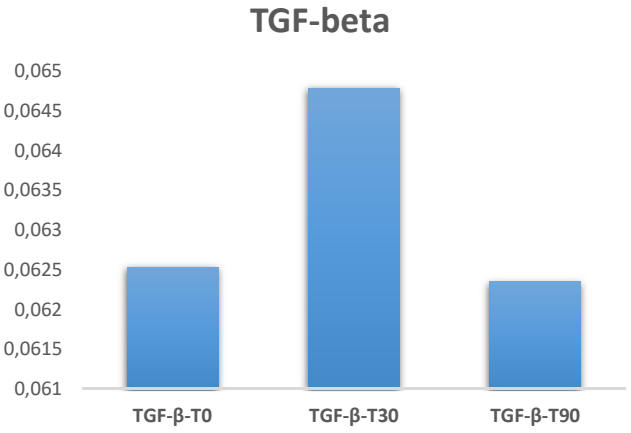












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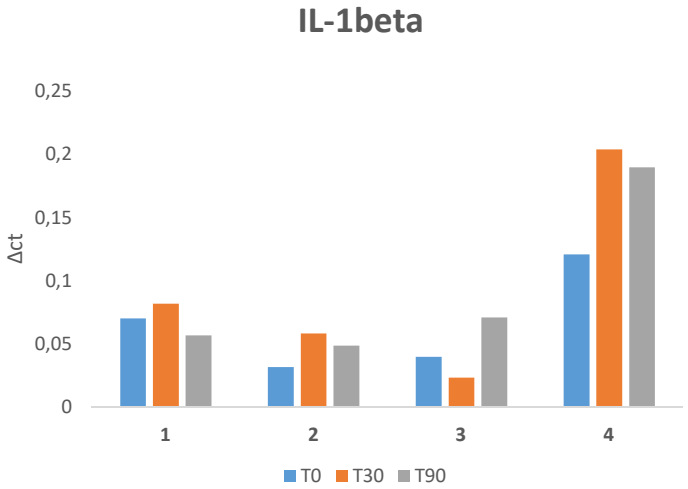
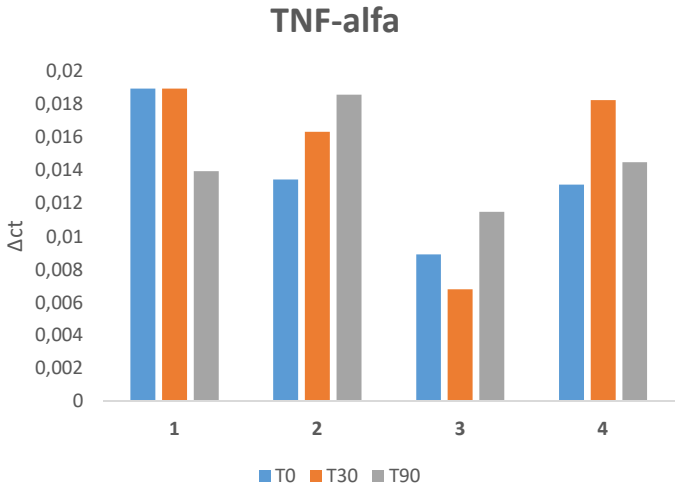
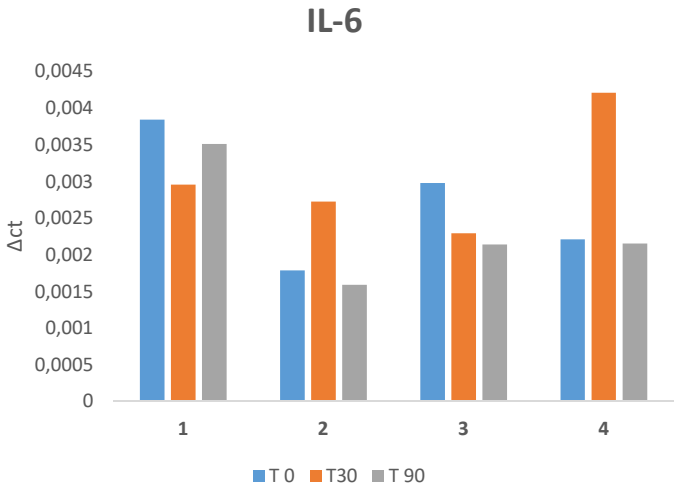
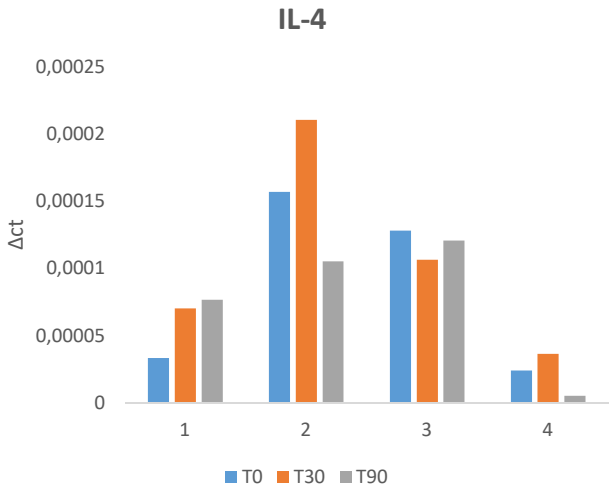
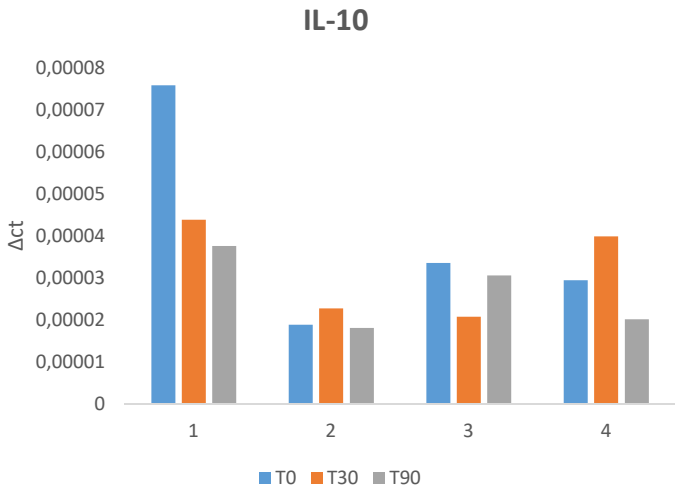
TEST TREVIGNANO Espressione degli mRNA delle citochine pro e anti-infiammatorie

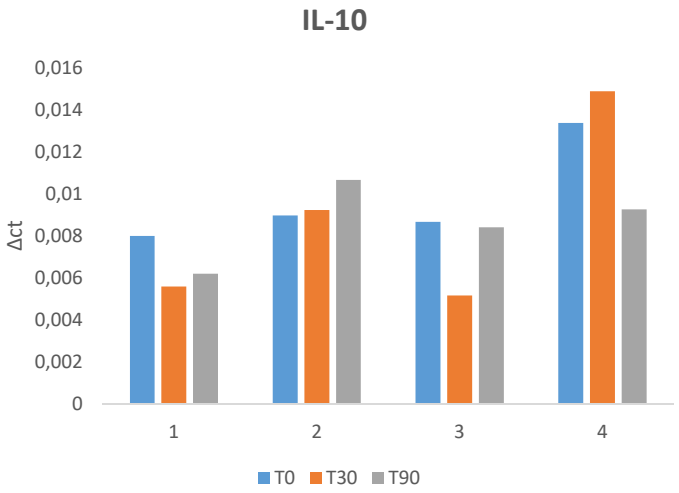












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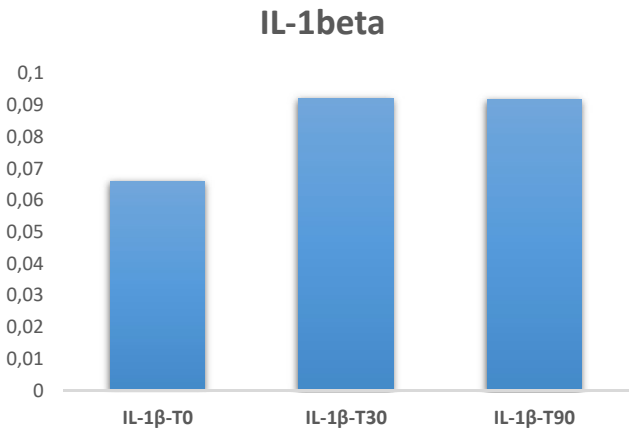

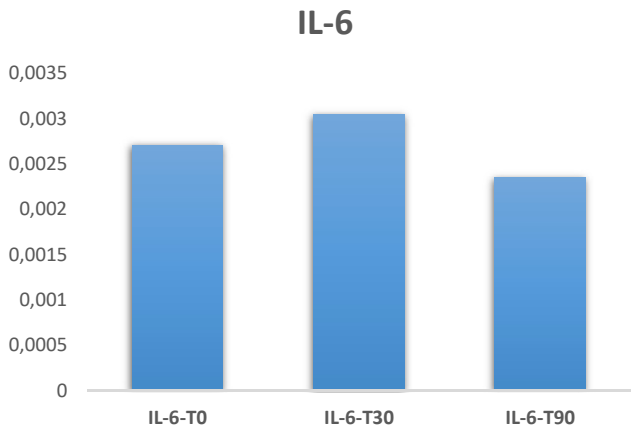

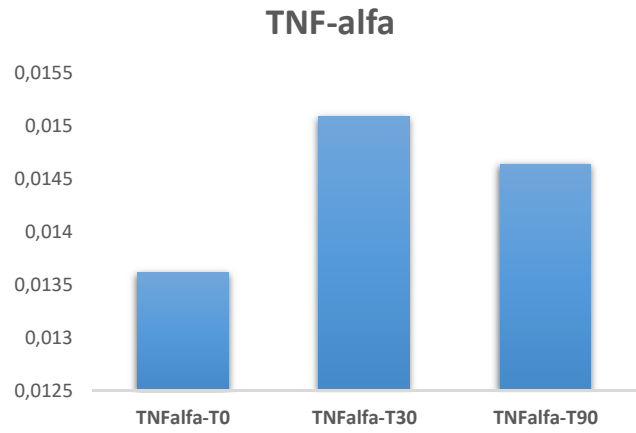

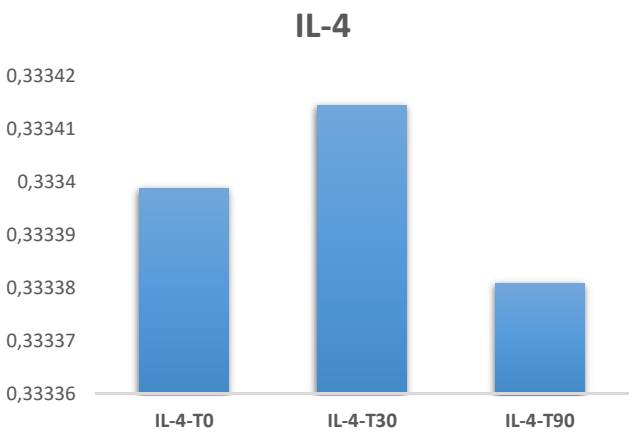

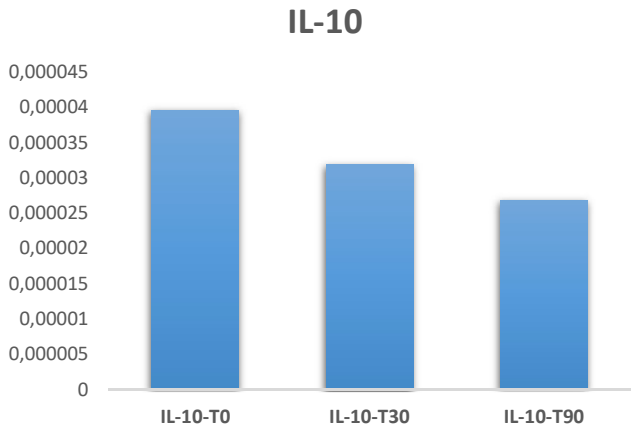

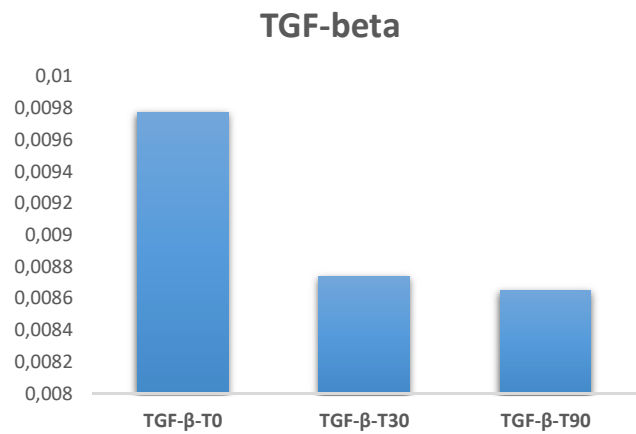

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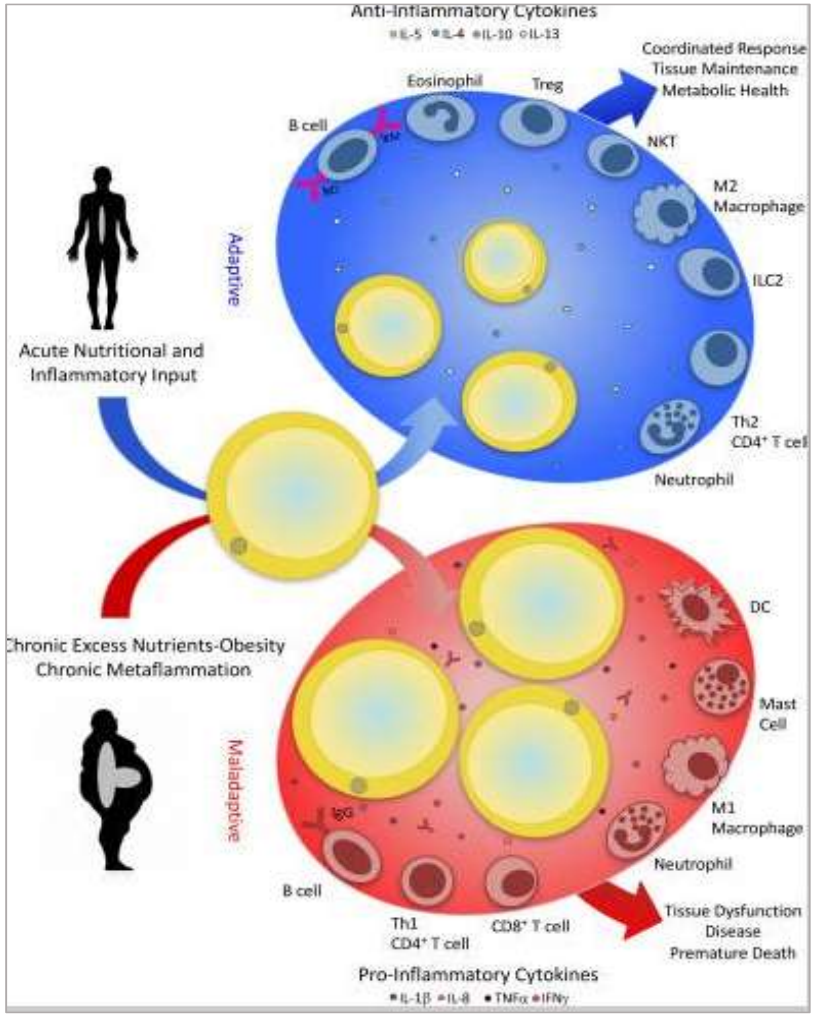
Lo stato infiammatorio sistemico è condizionato dallo **stato di nutrizione** (composizione corporea e qualità della dieta abituale) *[Hotamisligil, 2017].*



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Effects of the Ketogenic diet in overweight divers breathing Enriched Air Nitrox

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Gerardo Bosco[1], Alex Rizzato[1], Silvia Quartesan[1], Enrico Camporesi[2], Devanand Mangar[2], Matteo Paganini[3], Lorenzo Cenci[1], Sandro Malacrida[1], Simona Mrakic-Sposta[4], Sara Moretti[4] & Antonio Paoli[1]

antioxidants

MDPI

Review

Anti-Oxidant and Anti-Inflammatory Activity of Ketogenic Diet: New Perspectives for Neuroprotection in Alzheimer's Disease

Alessandro Pinto [1,*], Alessio Bonucci [2], Elisa Maggi [2], Mariangela Corsi [2] and Rita Businaro [2]

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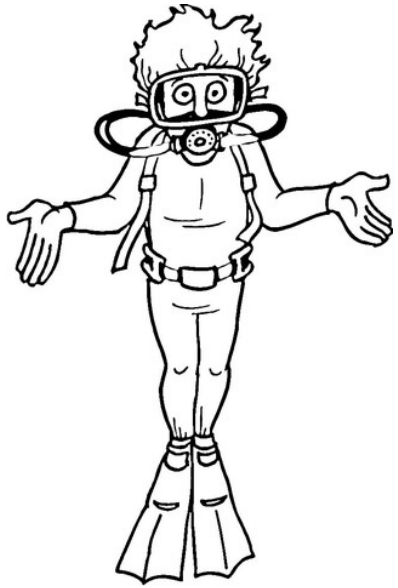
rita.businaro@uniroma1.it

CONCLUSIONI

- Dopo esposizione ad atmosfera iperbarica aumentano i livelli di mRNA delle citochine infiammatorie, a cui consegue un aumento speculare delle citochine anti-infiammatorie.

- Questo dato non è sempre correlato ad una variazione a livello proteico probabilmente perché 30 e 90 minuti sono tempi troppo brevi per osservare differenze dell'espressione proteica considerando anche la diversa cinetica delle citochine

- Migliorare lo stato di nutrizione, composizione corporea e abitudini alimentari, potrebbe influenzare positivamente il profilo infiammatorio, riducendo i livelli di citochine pro-infiammatorie e conseguentemente uno dei principali fattori di rischio nello sviluppo di malattie cronico-degenerative.



rita.businaro@uniroma1.it

RINGRAZIAMENTI

Laboratorio di Neuromorfologia Dipartimento di Scienze e Biotecnologie Medico-Chirurgiche . Università La Sapienza

Dott.ssa Federica Armeli
Dott. Alessio Bonucci
Dott.ssa Elisa Maggi

rita.businaro@uniroma1.it