

Heat shock proteins (HSP)

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Description

This lecture note on “**Heat shock proteins (HSP)**” were prepared and delivered to my BVSc.&A.H students studying Veterinary Pathology courses. This course was offered during the academic year 2022-23 in the second professional year at College of Veterinary & Animal Sciences, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India. I had tried my level best to extract the contents simplify the facts in easy to memories in very short time. Further constructive suggestions to improve this lecture note are always welcome its users on my email and whatsapp.

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Definition

- These are specific group of proteins expressed/produced in the cells of variety of organisms (Almost all) ranging from prokaryote (Bacteria) to higher organism (plants, insects and mammals) in response to sub-lethal injurious stimuli.

Eg of Stress stimulus for HSP induction

- Heat & Cold stress
- Infection & inflammation
- Oxidative stress (Free radical injury)
- wound healing & Tissue remodeling
- Hypoxia & water deprivation
- Toxicity: Heavy metals , ethanol
- UV exposure,
- Viruses & Toxins,
- And other stressors

Salient characteristics

Produced in two ways

1. Consecutively: Normal processes
 2. Induced : Stress conditions
- Synonym : Stress proteins
 - Discovered by: 1962 by Ferruccio Ritossa (When characteristic puffing of the chromosomes of *Drosophila* increased synthesis of HSP against heat stress was observed).
 - Present and produced in response to number to stress stimuli.
 - Stress → Increased transcription → increased expression
 - Conserved

Function

1. Folding : Newly synthesized proteins
 2. Refolding : Injured proteins due to stress
 3. Degradation : Mis-folded proteins
- Act as molecular chaperones
 - **Proteostasis**: Responsible for proper/correct 3D folding of proteins, stabilization and maintaining structural integrity of proteins.
 - Transport / secretion of proteins across the membranes of cellular organelles and from cell
 - Participate in signal transduction
 - Immunity: Antigen presentation (MHC-I & MHC-II)
 - Able to interact with PRR (TLRs) → Activate APC by upregulating MHC co-stimulatory molecules & pro-inflammatory cytokines
 - Apoptosis regulation

Example of HSP

- Depending on molecular weight
- HSP33 (33kd)
- HSP 40
- **HSP60 (60kd)**
- **HSP70**
- **HSP90** : Highly conserved → ubiquitously expressed in all organism (except archaea)
- HSP100
- Small heat-shock proteins (sHSPs)

Application/Uses

- HSP 90: Diagnosis, prognosis & treatment of tumor/cancer
- HSP70 & small HSPs: Therapy of neurodegenerative disorders, ischemia, autoimmunity and graft rejection etc
- Anti cancer therapy/**Cancer vaccines**: HSP 90 inhibition (Heritable genetic alteration is key in tumor progression. Hsp90 has the potential to have a significant impact on tumour heterogeneity, survivability after altered carcinogenic mutation & phenotypic diversification, which can promote malignancy and the development of treatment resistance).
- Treatment of autoimmune disorder: Eg. systemic lupus erythematosus (SLE), rheumatoid arthritis

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