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*Agrobacterium*heat-shock proteome

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Abstract

A study of the proteins produced by *Agrobacterium tumefaciens* after heat shock gives clues to how it adapts to environmental stress

Significance and context

The bacterium *Agrobacterium tumefaciens* causes the serious disease of crown gall in many commercially important dicotyledonous plants. The disease is characterized by the formation of large tumor-like swellings (galls) at the crown of the plant, just above soil level. Tumors are caused by the transfer of part of *A. tumefaciens* DNA to the plant cell. Because of its horticultural importance and its use as a vector for genetic engineering in plants, *A. tumefaciens* is very well characterized genetically and biochemically, and its genome has been completely sequenced. Now, Rosen *et al*. have looked at how the bacterium responds to heat shock (a brief exposure to 42°C), and what proteins it produces under the latter conditions. In bacteria, transcription of genes encoding heat-shock proteins is most commonly controlled by the CIRCE (controlling inverted repeat of chaperone expression)-HrcA regulatory system and by the RpoH system, which encodes a σ^{32} sigma factor (a gene-regulatory transcription factor). Rosen *et al.* have found a complex response to heat shock in *A. tumefaciens*, including a large number of proteins whose production is independent of the action of RhoH.

Key results

The sets of proteins produced by *A. tumefaciens* under standard conditions and after heat shock were compared using two-dimensional gel electrophoresis. In the latter case, 56 heat-shock-specific proteins were identified, which could be subdivided into three groups: RpoH-dependent proteins (24 proteins); the chaperones GroEL and GroES, production of which is repressed by HrcA under non-heat-shock conditions; and 32 proteins whose production depends on hitherto unknown regulatory mechanisms, as they were produced by an *rpoH* mutant under heat-shock conditions. An example of a protein produced independently of both RpoH and HrcA is protein H35, a high-affinity phosphate-transport protein involved in the phosphate influx that occurs during heat shock. A comparison of the heat-shock proteins produced by an *rpoH-hrcA* double mutant with those produced by a wild-type strain suggested a pleiotropic effect, which was not observed when both single mutants were considered separately, and still needs to be deciphered. Heat-shock proteins sequenced and identified include σ^{32}-dependent and

σ^{32}-independent forms of SmoM, a periplasmic mannitol-binding protein; H26-G, a general stress protein that functions as an L-threonine aldolase, responsible for the conversion of serine into glycine; PstB, a hypothetical transcriptional regulator; a ribosomal protein, L7/L12; and a ketol acid reductoisomerase.

Links

The entire genome sequence of *A. tumefaciens* C58 is presented at the *Agrobacterium tumefaciens* C58 Cereon genome page, and more detailed information about plant diseases mediated by *A. tumefaciens* is available at The Microbial World: biology and control of crown gall.

Conclusions

Analysis of heat-shock-induced proteins in *Agrobacterium*will strengthen our understanding of how the β-proteobacteria, the group to which *Agrobacterium* belongs, adapt to stress-inducing conditions. It may also be useful in understanding the very closely related *Brucella* species, the cause of brucellosis in humans and other animals.

Reporter's comments

The work by Rosen *et al*. describes a partial characterization of heat-shock proteins produced by the plant pathogen *A. tumefaciens*. Future work should, for instance, include the determination of the relevance of the heat-shock proteins studied here for the induction of particular plant diseases and whether abolition of their production also blocks the induction of the disease. It would furthermore be interesting to search for similar heat-shock or other stress-induced proteins in, for instance, *Brucella* sp., and unravel the importance of these proteins for infection of humans.

Table of links

Journal of Bacteriology

Agrobacterium tumefaciens C58 Cereon

The Microbial World: biology and control of crown gall

References

1. Rosen R, Büttner K, Becher D, Nakahigashi K, Yura T, Hecker M, Ron EZ: Heat shock proteome of *Agrobacterium tumefaciens*: evidencefor new control systems. J Bacteriol. 2002, 184: 1772-1778. 0021-9193