

(S5-D) A KNOWLEDGE-BASED APPROACH FOR DIAGNOSIS AND CONTROL OF
PHENYLALANINE PRODUCTION BY A RECOMBINANT *ESCHERICHIA COLI*

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Already for two decades the automatic control of fermentation processes has been a subject of intensive research. The interest in this field was growing rapidly during the last years because of its theoretical and practical importance. However, despite the achieved results, there are still many unsolved problems ensuing mainly from the great complexity and the unusual characteristics of the living systems. The serious difficulties faced call for revision of the methods and techniques used in modeling and control of fermentation processes. To compensate for the shortcomings of the traditional control concepts, recently some new trends have arisen, among which most significant is the application of the modern AI methods to the process control. Our work has been dedicated to the development and application of a system for control of fermentation processes utilizing such techniques, particularly the knowledge-based control approach for structure-variable processes. The proposed control system was applied on the process for phenylalanine production by the fed-batch cultivation of a recombinant *Escherichia coli*. To accumulate consistent amount of expert knowledge required for the practical development of the control system, the general characteristics of the

process was investigated including the structural transformations of the microbial system during the cultivation, as well as several other phenomena which are directly related to the control of the process, e.g. the excretion of acetic acid, the gradual decrease of the oxidative capacity of the cell, the dependence of the CO₂ evolution on the glucose feeding, etc. As a result, some important conclusions about the strategies for control of this cultivation were drawn out. The practical development and functioning of the knowledge-based part and the algorithmic modules will be presented in relation with the physiological peculiarities of the microbial system. In the last part, the results from a cultivation conducted under control of the developed system will be presented and commented.