

# PCR扩增试验的动力学数学模型 The Kinetic and Mathematical Model of PCR Amplification Experiment

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**摘要** PCR技术已日趋成熟, 但因为影响因素较多、反应过程比较复杂, 直到目前PCR技术已创立近二十年, 尚未能给出较好的描述PCR反应的数学方法。我们根据它的基本原理提出了能够描述其反应过程的动力学方程:  $W_{amp} = [N_{targ} \times (1+P)^{n1+0.5 \times Cenz} \times U \times P \times C_{eactiv} \times (n-n1) - N_{targ} \times (1+n \times P)] \times Cu \times M$ , 准确地描述了PCR反应的产物积累规律, 建立了PCR反应的动力学数学模型。用动力学数学模型预测的PE 7700仪器的CT值与仪器的实际数值一致。动力学数学模型配合适当的监测设备可以构成自动化的PCR定量仪器。PE 7700仪器使用本动力学模型处理、分析数据, 定量结果的准确性会更好。各实验室可根据各自的实验条件, 由模型估算PCR产物数量, 为PCR后产物继续处理提供较准确的数量信息。本模型阐明了PCR反应在多次循环后必然由指数扩增转变为线性扩增的分子基础, 为定量PCR提供了准确的计算方法。

**Abstract:** The PCR technique has been set up for nearly twenty years and is becoming more and more ripe. But because of the multiple influencing factors and complicated reaction procedures, no mathematical method that can describe the PCR reaction has been given. On the basis of its elementary principle, we suggested a kinetic equation to describe the reaction procedure,  $W_{amp} = [N_{targ} \times (1+P)^{n1+0.5 \times Cenz} \times U \times P \times C_{eactive} \times (n-n1) - N_{targ} \times (1+n \times P)] \times Cu \times M$ . This equation can describe correctly the accumulation rule of PCR product and thus build up the kinetic-mathematical model of PCR reaction. The predicted CT value of PE 7700 by the kinetic-mathematical model was in accordance with the real value detected by the machine. This kinetic-mathematical model accompanied by proper detecting equipment and computer could make an automatic PCR instrument, which would produce much better result. A laboratory can predict the amount of PCR product by this model and provide accurate information for further handling of PCR product according to its own condition. In this model, the molecular basis that PCR reaction is doomed to change from exponential amplification to linear amplification had been clarified.

**关键词** [数学模型](#) [PCR动力学](#) [定量PCR](#) [动力学方程](#) **Key words** [PCR](#) [PCR kinetic](#) [kinetic-mathematical model](#)

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