生物物理学报(2002) 18(2), 201-205

PDF文档

三氟氯氰菊酯对棉铃虫神经细胞钠及钙通道作用机理研究

贺秉军[1]、刘安西[1]、陈家童[1]、孙金生[2]、芮昌辉[3]
1 南开大学生命科学学院
2 天津水产研究所
3 中国农业科学院植物保护研究所

用膜片钳技术对比分析了棉铃虫三氟氯氰菊酯抗性品系(R)及其同源对照品系(S)幼虫离体培养中枢神经细胞Na^+通道的门控特性及杀虫剂对R和S神经细胞Na^+、Ca^{2+}通道门控过程的影响。结果表明,S神经细胞Na^+通道电流(S-I_{Na})在-50～-40mV激活,-20mV左右达峰值,R神经细胞Na^+通道电流(R-I_{Na})在-40mV左右激活,-10～0mV达峰值,即R-INa激活电压与峰值电压均向正电位方向移动约10mV,提示二者Na^+通道门控特性不同,R神经细胞Na^+通道功能发生了变异。三氟氯氰菊酯作用后,S-I_{Na}与R-I_{Na}的I～V曲线均向负电位方向移动约10mV,S-I_{Na}在20min后基本消失,而R-I_{Na}被阻断需时约90min,延长近5倍,其幅值有减小后再增大的现象。对Ca^{2+}通道分析表明,杀虫剂作用后,R及S神经细胞Ca^{2+}通道电流的I～V曲线均向负电位方向移动10～20mV,提示三氟氯氰菊酯对Ca^{2+}通道的门控过程也有影响。与R-INa幅值起伏变化相联系,可推知杀虫剂对神经细胞的毒性作用中,Na^+、Ca^{2+}通道均受影响。

EFFECTS OF CYHALOTHRIN ON THE SODIUM AND CALCIUM CHANNELS IN CENTRAL NEURONS OF Helicoverpa armigera

The properties of sodium currents of the central neurons isolated from the thoracic and abdominal ganglia of susceptible (S) and cyhalothrin-resistant (R) cotton bollworm, Helicoverpa armigera (Hübner) were studied with the whole-cell patch clamp technique.The effects of cyhalothrin upon the sodium and calcium channels of S and R neurons were also analyzed. The results showed that the sodium channels of R neurons had altered gating properties. Voltage-dependent activation of S sodium channels began from -50 to -40 mV and reached peak value at approximately -20 mV. In contrast, R channels were activated at approximately -40 mV and reached peak around -10~0 mV. Thus, the voltage-dependent activation and inactivation potential of sodium channels of R neurons was shifted approximately 10 mV in the positive direction. Consistent with these changes in gating behavior, R central neurons were less sensitive to the cyhalothrin, as evidenced by the blocking time. The sodium currents of S neurons were entirely sup-pressed by 1.0×10^{-7} mmol·L^{-1} cyhalothrin within 20 min, while it required more than 90 min to block the R currents. The current-voltage relationships for the sodium channels of S and R neurons shifted towards more negative potentials (10 mV or more) in 5 min when the cyhalothrin was added to the external solution. Further, the value of R currents varied several times during recording, which indicated that there were other mechanisms involved in the detoxification. The current-voltage relationships for the calcium channels of S and R neurons was shifted 10~20 mV in the negative direction after the action of cyhalothrin, indicating that the cyhalothrin can also affect the gating behavior of calcium channels. Taken together, the results suggest that the cyhalothrin can affect the gating behavior of both sodium and calcium channels of S and R neurons. The sodium channels of R have altered properties, and are less sensitive to cyhalothrin. This is related to the nervous system insensitivity.

关键词

棉铃虫(Helicoverpa armigera); Na^{+}通道(Sodium channel); Ca^{2+}通道(Calcium channel); 三氟氯氰菊酯(Cyhalothrin); 膜片钳(Patch clamp)