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NOTE

Synthesis and Insecticidal Activity of Two New Chlorantraniliprole Derivatives

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Two chlorantraniliprole derivatives were designed and synthesized. Their structures were characterized by ^{1}H NMR, ^{13}C NMR and HR-MS. Biological assay showed compounds **2**, **3** had 40 % activity and 60 % activity against oriented armyworm at the concentration 5 mg/L and 200 mg/L respectively.

Keywords: Chlorantraniliprole, Oriented armyworm, Bioassay.

The oriental armyworm, *Lepidoptera, noctuidae*, is a serious agricultural pest of more than 16 families of 104 kinds of plants, such as wheat, rice, corn, cotton, beans. It is distributed over eastern Asia, especially in China[1] and the western pacific region. It has become the important agricultural pests because of its cluster, migratory, omnivorous and gluttonous. More and more pesticides were synthesized to control this pest. But the capability of armyworm to rapidly develop resistance is more and more strong. The ecobiological problem is also becoming serious recently. Therefore, emphasis should be placed on the discovery of agents that act on new biochemical targets to protect crop and manage pest effectively.

It was reported that insect calcium channels would offer a pesticide target for science exploitation[2,3]. Calcium homeostasis plays a key role in multiple biological processes such as muscle contraction. Ryanodine receptor channels, which regulate release of internal calcium stores is a way of muscle contraction[4]. Now, two representative molecules, chlorantraniliprole and cyantraniliprole (Fig. 1A and B) which showed exceptional insecticidal activity on a broad range of *Lepidopera, Coleoptera, Diptera and Isoptera* insects have been marketed[5].

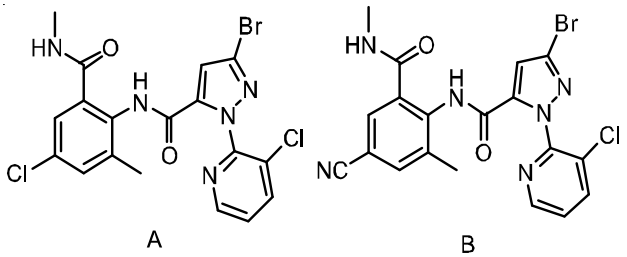
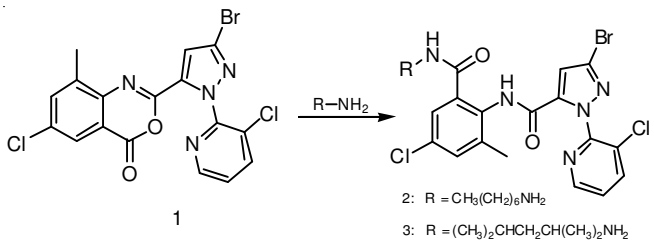


Fig. 1. Structure of chlorantraniliprole and cyantraniliprole

In this work, one modification was done with chlorantraniliprole as leading compound to obtain two potential insecticides. The insecticidal activities of two novel compounds against oriental armyworms were tested. Chlorantraniliprole, indoxacarb and abamectin were used as control insecticides.

Melting points were determined in open capillary tubes and were uncorrected. The products were purified by column chromatography by using silica gel (200-300 mesh). NMR spectra were run on a Varian-400 at room temperature with TMS as an internal standard and $CDCl_3$ as solvents. Mass spectra were recorded with a JEOL MS-D 300 mass spectrometer. The reactions were monitored by TLC with ultraviolet light; analytical thin-layer chromatography was carried out on silica gel GF_{254}. All raw materials were purchased from commercial sources. Reagents were all analytically or chemically pure. All the solvents and liquid reagents were dried by standard methods or distilled before use.



Synthesis of intermediate 1: 1 was synthesized in five steps based on the reported procedures in literatures[6-10].

Synthesis of compound 2: To a stirred solution of compounds **1** (50 mg, 0.11 mmol) in tetrahydrofuran (5 mL), *n*-heptylamine (25 mg, 0.22 mmol) was added at 50°C. After

5 h, TLC showed the complete consumption of compound **6**. The mixed solution was evaporated to remove the tetrahydrofuran. The residue was dissolved in dichloromethane (20 mL). The organic layer was washed with H_2O (3 × 15 mL), dried over anhydrous sodium sulfate and concentrated to give crude product, which was recrystallized from dichloromethane and hexane (1:1.5) to yield target compound **2**, 36 mg 58 %, m.p. 162-168°C. ^{1}H NMR (400 MHz, $CDCl_3$) δppm = 0.89 (t, *J* = 7.2 Hz, 3H, CH_3), 1.28 (m, *J* = 14 Hz, 8H, $(CH_2)_4$), 1.52 (m, *J* = 7.2 Hz, 2H, CH_2CH_3), 2.163 (s, 3H, Ph-CH_3), 3.35 (m, *J* = 7.2 Hz, 2H, CH_2NH), 6.142 (s, 1H, pyrazole-H), 7.151 (s, 1H, Ph-H), 7.17 (d, *J* = 6.4 Hz, 1H, NHCO), 7.212 (s, 1H, Ph-H), 7.36 (dd, *J* = 4.8 Hz, 8 Hz, 1H, 5-H pyridine), 7.83 (dd, *J* = 4.8 Hz, 1.6 Hz, 1H, 4-H pyridine), 8.44 (dd, *J* = 4.8 Hz, 1.6 Hz, 1H, 6-H pyridine), 10.123 (s, 1H, $NHCOCH_2$); ^{13}C NMR (400 MHz, $CDCl_3$) δppm = 14.064 ($\underline{C}H_3CH_2$), 18.701 (CH_3-Ph), 22.590 ($\underline{C}H_2CH_3$), 26.919 ($\underline{C}H_2(CH_2)_2NHCO$), 28.911 ($\underline{C}H_2(CH_2)_2CH_3$), 29.372 ($\underline{C}H_2CH_2NHCO$), 31.683 ($\underline{C}H_2$ CH_2CH_3), 40.342 ($\underline{C}H_2NHCO$), 111.029 (4-C pyrazol), 124.346 (3-C pyrazol), 125.634 (3-C, 5-C pyrizine), 128.211(5-C Ph), 129 (6-C Ph), 131.268 (4-C Ph), 132.256 (1-C Ph), 132.645(3-C Ph), 133.221 (5-C pyrazol), 138.722 (4-C pyrizine), 138.813 (2-C Ph), 146.789 (6-C pyrizine), 149.092 (2-C pyridine), 156.563 ($\underline{C}$ONHPh), 167.842 ($\underline{C}$ONH); HR-MS (ESI) calcd. for $C_{24}H_{26}N_5O_2BrCl_2$ (M + 1), 566.0725, found, 566.0740.

Synthesis of compound 3: According to above procedure for preparation of compound **2**, the target compound **3** was prepared from compound **1** (50 mg, 0.11 mmol), 2,4,4-trimethylpentan-2-amine (28 mg, 0.22 mmol, 2N), tetrahydrofuran (5 mL) and recrystallized from dichloromethane and hexane (1:2). (35 mg, 55 %), m.p. 202-206 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 0.891 (s, 9H, $(CH_3)_3C$), 1.298 (s, 6H, $(CH_3)_2C$), 1.563 (s, 2H, CH_2), 2.182 (s, 3H, Ph-CH_3), 7.009 (s, 1H, pyrazole-*H*), 7.23(d, *J* = 1.6 Hz, 1H, Ph-H), 7.31 (dd, *J* = 4.8, 8 Hz, 1H, 5-H pyridine), 7.78 (d, *J* = 8 Hz, 1H, 4-H pyridine), 7.78 (d, *J* = 8 Hz, Ph-H), 8.37 (d, *J* = 4.8 Hz, 1H, 6-H pyridine), 11.840 (s, 1H, NHCOC); ^{13}C NMR (400 MHz, $CDCl_3$) δppm = 19.435 (CH_3-Ph), 27.258 ($C(CH_3)_3$), 31.180 (($CH_3)_2C$), 31.233 (($CH_3)_3C$), 52.974 ($C(CH_3)_2$), 55.986 (CH_2), 110.771 (4-C pyrazol), 125.785 (3-C pyrazol), 127.949 (3-C, 5-C pyridine), 128.089 (5-C Ph), 129.060 (6-C Ph), 130.468 (4-C Ph), 133.137 (1-C Ph), 134.783 (3-C Ph), 136.288 (5-C pyrazol), 139.068 (4-C pyrizine), 140.096 (2-C Ph), 146.767 (6-C pyridine), 148.913 (2-C pyridine), 155.662 (CONHPh), 172.421 (CONH); HR-MS(ESI) calcd. for $C_{25}H_{28}N_5O_2BrCl_2$ (M + Na), 602.0701; found, 602.1055.

All of the tested compounds had the purity of more than 90 %. All bioassays were performed on test oriental armyworms (*Mythimma separata*) reared in the lab and repeated at 25 ± 1 °C according to statistical requirements. The insecticidal activities of compounds against oriental armyworms with chlorantraniliprole, indoxacarb and avermectin as compared pestcides were tested according to the reported procedure[1]. The result was summarized in Table-1.

TABLE-1
INSECTICIDAL ACTIVITY OF COMPOUNDS **2, 3**, CHLORANTRANILIPROLE, INDOXACARB AND AVERMECTIN AGAINST ORIENTAL ARMYWORM

Compounds	Concentration (mg/L)	Mortality rate (%)
2	200	100
	10	100
	5	40
3	200	60
Chlorantraniliprole	200	100
	10	100
	5	100
	2.5	100
	1	100
	0.5	100
	0.25	100
	0.1	80
Indoxacarb	200	100
	10	100
	5	40
Abamectin	200	100
	10	100
	5	100
	2.5	100
	1	100
	0.5	100
	0.25	0

Among these compounds, the bioassays indicated that compound **2** showed 40 % activity at the concentration 5 mg/L, has much lower ativity than chlorantraniliprole and avermectin, but has the same activity to oriented armyworm as that of indoxacarb. Compound **3** showed 60 % activity at the concentration 200 mg/L, which was much lower than all compared pesticides.

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REFERENCES

1. R.L. Chen and Z.S. Bao, *Insect Sci. Appl*., **8**, 571 (1987).
2. J.R. Bloomquist, *Annu. Rev. Entomol*., **41**, 163 (1996).
3. L.M. Hall, D. Ren, G. Feng, D.F. Eberl, M. Dubald, M. Yang, F. Hannan, C.T. Kousky and W. Zheng, Molecular Actions of Insecticides on Ion Channels, American Chemical Society, ed. J.M. Clark, Washington, DC, p. 162-172, (1995).
4. D. Cordova, E.A. Benner, M.D. Sacher, J.J. Rauh, J.S. Sopa, G.P. Lahm, T.P. Selby, T.M. Stevenson, L. Flexner, S. Gutteridge, D.F. Rhoades, L. Wu, R.M. Smith and Y. Tao, *Pestic. Biochem. Physiol*., **84**, 196 (2006).
5. Q. Feng, Z.L. Liu, L.X. Xiong, M.-Z. Wang, Y.-Q. Li and Z.-M. Li, *J. Agric. Food Chem*., **58**, 12327 (2010).
6. G.P. Lahm, T.M. Stevenson, T.P. Selby, J.H. Freudenberger, D. Cordova, L. Flexner, C.A. Bellin, C.M. Dubas, B.K. Smith, K.A. Hughes, J.G. Hollingshaus, C.E. Clark and E.A. Benner, *Bioorg. Med. Chem. Lett*., **17**, 6279 (2007).
7. G.P. Lahm, T.P. Selbey and T.M. Stevenson, CN1003913380.
8. T. Masaki, *Mol. Pharmacol*., **69**, 1733 (2006).
9. G.P. Lahm and S.F. Mccann, WO03015518A1 (2003).
10. R.A. Berger and J.L. Flexner, WO03024222A1 (2003).