

INSECTICIDAL ACTIVITIES OF *ABROMA AUGUSTA* (L.) CHLOROFORM AND METHANOL EXTRACTS AGAINST *TRIBOLIUM* *CASTANEUM* (HERBST) ADULTS

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Abstract: The chloroform and methanol extracts of the leaves, root wood, stem bark, stem wood and seeds of *Abroma augusta* (L.) (Ulatkambal) were tested against *Tribolium castaneum* (Herbst) adults through residual film assay. The seed extracts (CHCl₃ and MeOH) were found to offer the highest mortality of the beetles and the LD₅₀ values were 3046.083, 247.9217 and 75.96001 µg/cm² and 6598.793, 340.4855 and 113.6461 µg/cm² for the (CHCl₃ and MeOH) extracts for 30min, 24 and 48h of exposures respectively. The root wood extracts gave LD₅₀ values of 1127.785, 312.5822 and 146.3708 µg/cm² and 1689.468, 449.8259 and 134.9692 µg/cm² for the (CHCl₃ and MeOH) extracts for 30min, 24 and 48h of exposures respectively. These were followed by the leaf (CHCl₃ and MeOH) extracts that gave LD₅₀ values of 3466.807, 450.3049 and 175.7438 µg/cm² and 4654.238, 1010.538 and 333.7202 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24h and 48h of exposure respectively. The stem bark extracts (CHCl₃ and MeOH) gave LD₅₀ values of 3295.859, 1137.558 and 363.1539 µg/cm² and 3717.851, 566.2215 and 230.7044 µg/cm² for the (CHCl₃ and MeOH) extracts for 30 min, 24 and 48 h of exposure respectively. The stem wood extracts (CHCl₃ and MeOH) of *A. augusta* did not show any activity against the beetles. According to the intensity of activity observed through mortality of the adult beetles the potentiality of the chloroform extracts could be arranged in a descending order of seeds > root wood > leaf > stem bark and for the methanol extracts, seed > root wood > stem bark > leaf.

Key words: *Abroma augusta*, Insecticidal activity, Chloroform and methanol extracts, *Tribolium castaneum*.

সারাংশ: *Tribolium castaneum* (Herbst) এর পূর্ণাংগ পোকের উপর *Abroma augusta* (L.) (উলটকম্বল) -এর পাতা, মূলের কাঠ, কাণ্ডের বাকল, কাণ্ডের কাঠ ও বীজের ক্লোরোফর্ম ও মিথানল নির্যাসের বিষক্রিয়া পর্যবেক্ষণ করা হয়। বীজের ক্লোরোফর্ম ও মিথানল নির্যাস ৩০ মিনিট, ২৪ ঘন্টা ও ৪৮ ঘন্টায় পোকগুলির উপর সবচেয়ে বেশী কার্যকারিতা প্রদর্শন করে যার LD₅₀ ছিল যথাক্রমে 3046.083, 247.9217 ও 75.96001 µg/cm² এবং 6598.793, 340.4855 ও 113.6461 µg/cm²। মূলের কাঠের ক্লোরোফর্ম ও মিথানল নির্যাসের ক্ষেত্রে LD₅₀ ছিল যথাক্রমে 1127.785, 312.5822 ও 146.3708 µg/cm² এবং 1689.468, 449.8259 ও 134.9692 µg/cm²। পাতার ক্লোরোফর্ম ও মিথানল নির্যাসের ক্ষেত্রে যথাক্রমে 3466.807, 450.3049 ও 175.7438 µg/cm² এবং 4654.238, 1010.538 ও 333.7202 µg/cm² কার্যকারিতা প্রদর্শন করে। কাণ্ডের বাকলের ক্লোরোফর্ম ও মিথানল নির্যাসের ক্ষেত্রে 3295.859, 1137.558 ও 363.1539 µg/cm² এবং 3717.851, 566.2215 ও 230.7044 µg/cm² কার্যকারিতা প্রদর্শন করে। কাণ্ডের কাঠের কোন নির্যাস *Tribolium castaneum* -এর উপর কোন কার্যকারিতা প্রদর্শন করে নাই। কার্যকারিতার মাত্রা অনুসারে ক্লোরোফর্ম নির্যাসগুলিকে যথাক্রমে বীজ > মূলের কাঠ > পাতা > কাণ্ডের বাকল এবং মিথানল নির্যাসগুলিকে বীজ > মূলের কাঠ > কাণ্ডের বাকল > পাতা ক্রমানুসারে সাজানো যায়।

Introduction

Botanical pesticides, as an alternative to the conventional chemical agents for insect control are now-a-days very popular among the pest control experts. They are more readily biodegradable and therefore, are less likely to contaminate the environment. Moreover, natural compounds break down readily in soil and are not stored in plant or animal tissues. The use of phytochemicals as powder, oil and extracts for the control of stored-product insect pests has much agricultural importance and recently has received much more attention because these insecticidal compounds are safer than synthetic pesticides, cheaper and can easily be obtained from plants with less sophisticated methods.

Abroma augusta L. (Sterculiaceae), commonly known as ulatkambal, is a large spreading bushy shrub with fibrous barks and irritant hairs. The branches and branch lets are downy. When freshly cut the root produces a thick gummy substance. The root bark is

tasteless, slimy, odorless and tough. When soaked in cold water for 3-4 days, the bark produces slimy mucilage which can be extracted (Anonymous 2006, Nandkarni 2002).

Being a medicinal plant, *A. augusta* contains antipathogenic properties and almost all the parts of the plant are used in the treatment of different diseases. Insecticidal activities of the plant have been demonstrated by a number of recent workers viz., Prajapati et al. (2003), Nanda (1997), Halim (2003), Hanif et al. (2010), Kirtikar and Basu (1918, 1999), Nandkarni (2002), Rahamtullah et al. (2010).

The rust-red flour beetle, *Tribolium castaneum* (Herbst) is a major pest of a wide range of stored commodities. The insecticidal activities of *A. augusta* extracts have been attempted and the investigation has been designed to evaluate the efficacy of the plant parts as a possible source of potential secondary metabolites to be used as environment-friendly pest control agents against *T. castaneum*.

Materials and Methods

Preparation of plant materials for extraction: The experimental plant (*A. augusta*) was collected from the campus of the University of Rajshahi, Bangladesh. After drying under shade the plant materials, viz. leaves, root wood, seeds, stem bark and stem-wood were powdered in a grinder separately.

Chemical extraction from the plant materials: Chloroform and methanol were selected as solvents to extract different parts of *A. augusta* separately. The ground dried materials were extracted with sufficient amounts of chloroform (500g × 1500ml × 3 times) for each of the items. Separate extracts were collected by the cool method after 72 hours of plunging for each of the materials. Extracts, thus obtained, were subjected to filtration and evaporation of the solvents. The residue were left and kept in a refrigerator after proper labeling.

Application of doses:

Through an *ad hoc* experiment a general concentration for the extracts was selected as 10 mg/2ml as the stock solution for surface film application to make other successive doses by serial dilution to give 1040, 780, 520, 260, 130 and 65 µg/cm² concentrations. The application of the doses was made by the residual film method (Busvine, 1971). For each dose 1ml of the extract was dropped on a Petri dish (70 mm diam.) in such a way that it made a uniform film over the Petri dish. Then the Petri dishes were air-dried and 10 beetles

(3-5-day old) were released in each of the Petri dishes with three replicates. A control batch was also maintained with the same number of insects after preparing the Petri dish by applying and evaporating the solvent only. Mortality data were recorded for 30min, 24h and 48h postexposure.

Statistical Analyses

The mortality of the beetles was corrected by the Abbott's (1925) formula:

$$P_r = \frac{P_o - P_c}{100 - P_c} \times 100 ; \text{ Where, } P_r = \text{Corrected mortality (\%);}$$

P_o = Observed mortality (%) and P_c = Control mortality (%).

Data were subjected to statistical analyses according to Finney (1947) and Busvine (1971). The experiment was conducted at a room temperature of $30 \pm 2^\circ\text{C}$.

Results and Discussion

The results have been presented in Tables 1 and 2 for the mortality recorded and have been shown in Fig.1 and 2. The seed extracts were found to offer the highest mortality of the beetles for both the solvents. According to the degree of activity observed through mortality of the adult beetles the potentiality of the chloroform extracts could be arranged in a descending order of seed > root wood > leaf > stem bark extracts and of the methanol extracts, seed > root wood > stem bark > leaf extracts.

Table 1 Dose-mortality effects of *A. augusta* extracts (CHCl₃) against *T. castaneum* adults.

Test part	Exposure period	LD ₅₀ value (µg/cm ²)	95% Conf. limits		Regression equation	χ ² Value (df)
			Lower limit	Upper limit		
Leaf	30 min.	3466.807	434.898	27635.810	Y = 2.112 + 0.816X	0.199(3)
	24 h	450.305	280.002	724.190	Y = 1.863 + 1.182X	1.549 (3)
	48 h	175.744	129.568	238.377	Y = 1.099 + 1.738 X	5.069 (3)
Root wood	30 min.	1127.785	465.277	2733.641	Y = 1.668 + 1.092X	0.447 (3)
	24 h	312.582	207.490	470.902	Y = 2.002 + 1.202X	0.124(3)
	48 h	146.371	98.901	216.626	Y = 1.936 + 1.415X	2.483(3)
Stem bark	30 min.	3295.859	889.985	12205.470	Y = 0.197 + 1.365X	0.229(3)
	24h	1137.558	538.928	2401.138	Y = 1.838 + 1.035X	0.529(3)
	48h	363.154	233.226	565.463	Y = 2.182 + 1.100X	1.219(3)
Seed	30 min.	3046.083	370.990	25010.390	Y = 2.258 + 0.787X	0.158(4)
	24h	247.922	131.750	466.527	Y = 2.895 + 0.879X	0.337(4)
	48h	75.960	54.368	106.128	Y = 2.364 + 1.402X	3.868(4)

Table 2 Dose-mortality effects of *A. augusta* extracts (CH₃OH) against *T. castaneum* adults.

Test part	Exposure period	LD ₅₀ value (µg/cm ²)	95% Conf. limits		Regression equation	χ ² -Value (df)
			Lower limit	Upper limit		
Leaf	30 min.	4654.238	496.941	43590.610	Y = 1.481 + 0.959 X	0.183(3)
	24 h	1010.538	376.168	2714.704	Y = 2.293 + 0.901 X	1.721(3)
	48 h	333.720	204.656	544.177	Y = 2.434 + 1.017X	1.662(3)
Root wood	30 min.	1689.468	591.451	4825.927	Y = 1.057 + 1.221X	0.242(3)
	24 h	449.826	259.868	778.641	Y = 2.288 + 1.022X	0.243(3)
	48 h	134.969	82.772	220.082	Y = 2.535 + 1.157X	3.755(3)
Stem bark	30 min.	3717.851	717.054	19276.680	Y = 1.323 + 1.030X	0.779(3)
	24h	566.222	358.554	894.166	Y = 1.993 + 1.092X	0.761(3)
	48h	230.704	156.868	339.295	Y = 1.225 + 1.597X	5.414(3)
Seed	30 min.	6598.793	285.020	152775.800	Y = 2.450 + 0.668 X	0.220(4)
	24h	340.486	161.627	717.271	Y = 2.824 + 0.860X	0.207(4)
	48h	113.646	77.444	166.772	Y = 2.558 + 1.188X	1.013(4)

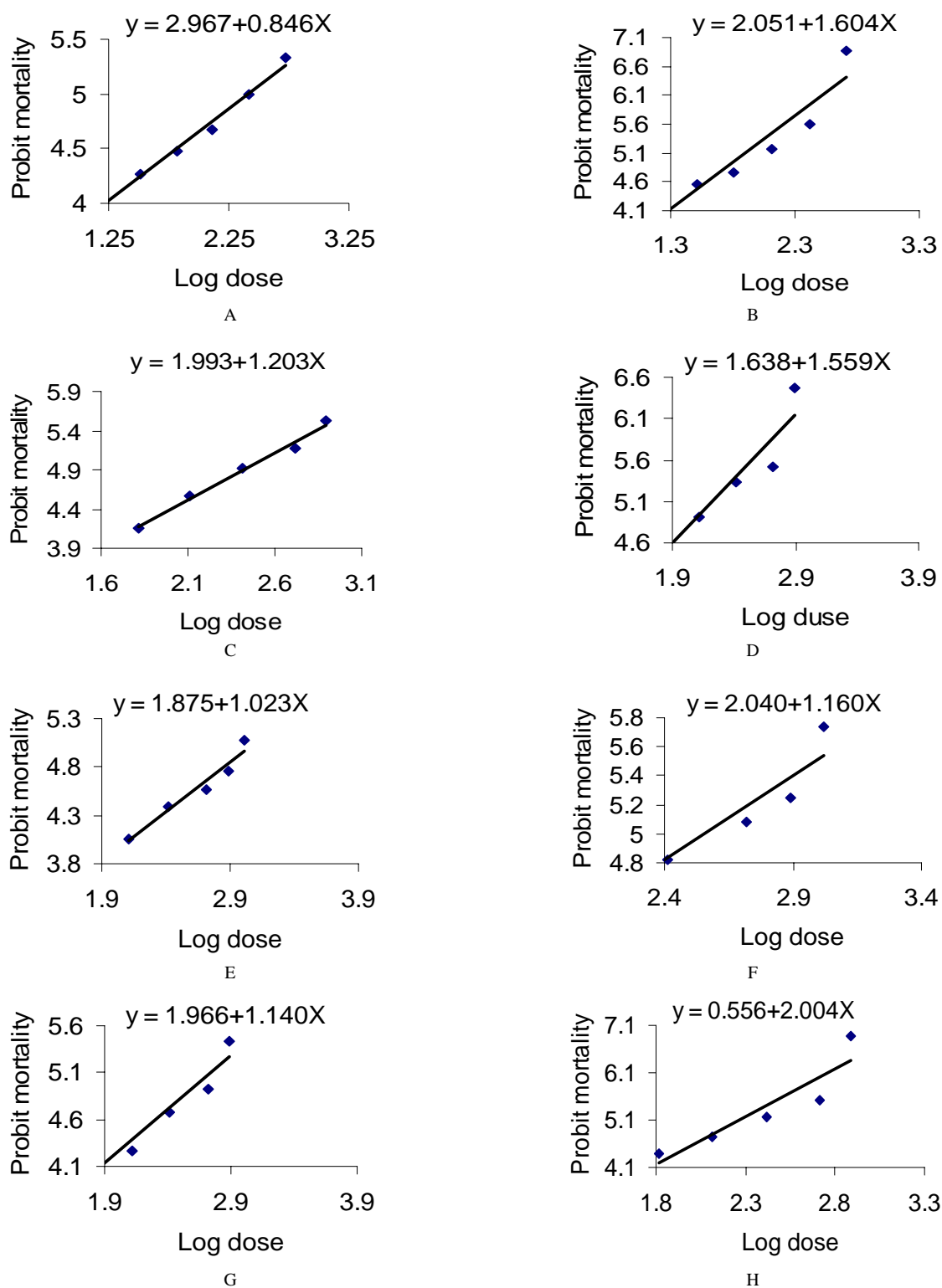


Fig.1 Probit mortality regression lines of the chloroform extracts of *A. augusta*: A- Seed/ 24 h; B- Seed/ 48 h; C- root wood/ 24 h; D- root wood/ 48 h; E- stem bark/ 24 h; F- stem bark/ 48 h; G- leaf/ 24 h and H- leaf/ 48 h of exposure against *T. castaneum* adults.

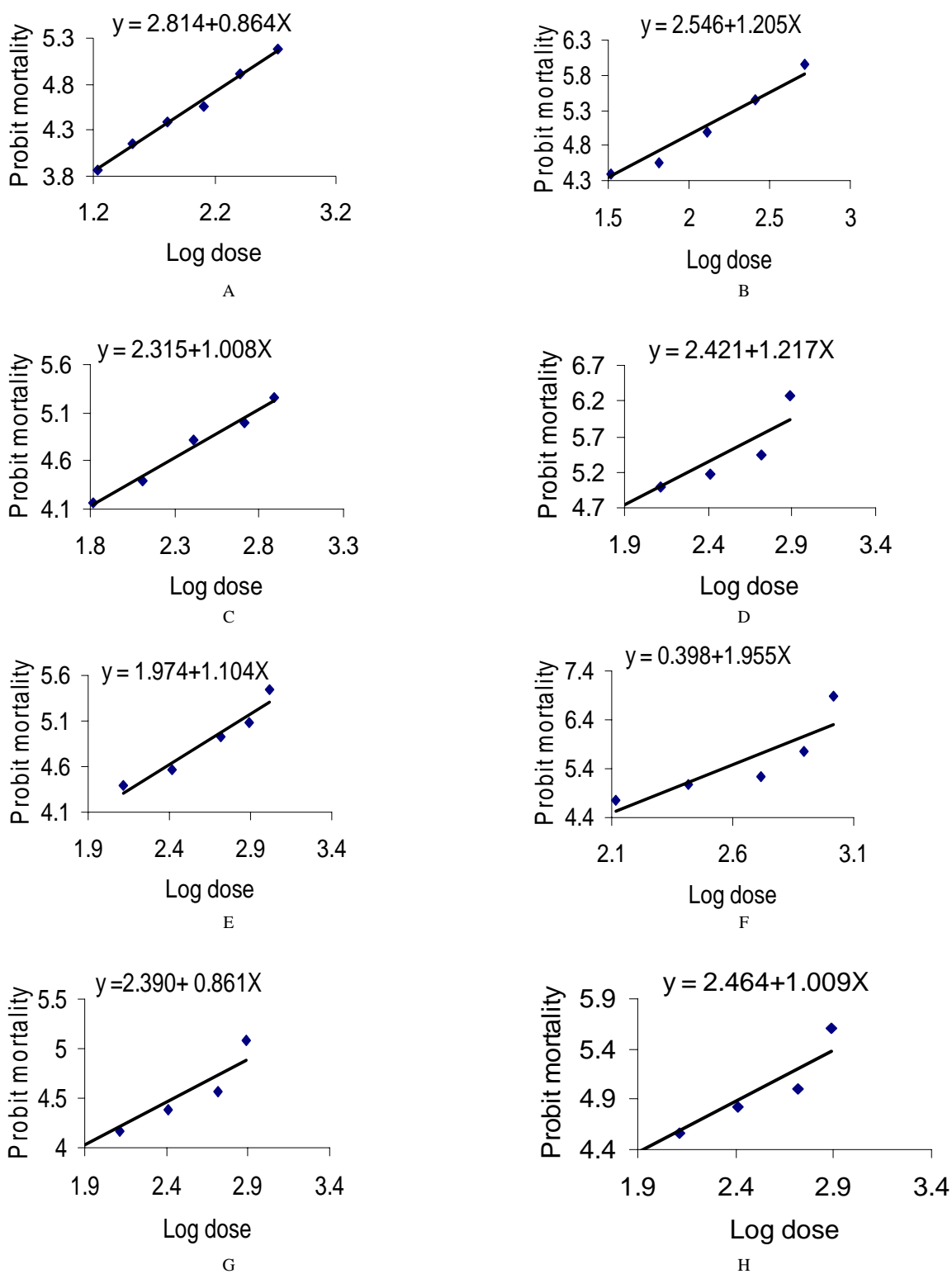


Fig. 2 Probit mortality regression lines of the methanol extracts of *A. augusta*: A- Seed/ 24 h; B- Seed/ 48 h; C- root wood/ 24 h; D- root wood/ 48 h; E- stem bark/ 24 h; F- stem bark/ 48 h; G- leaf/ 24 h and H- leaf/ 48 h of exposure against *T. castaneum* adults.

The seed extracts (of both the solvents) offered the highest mortality of *T. castaneum*. However, the comparatively higher doses of the root wood, stem bark and leaf extracts indicate weaker action. The test extracts produced mortality within 30 min of application just to prove their acute toxicity. The seed, root wood and stem bark extracts were found to possess bioactive potential(s) with comparatively higher insecticidal activity but the stem bark extract was comparatively mild in action followed by the leaf extract. The stem wood extract did not show any activity against *T. castaneum*. The present results support the previous work of Naqvi and Parveen (1991) who observed that the seed extract of *A. augusta* showed a remarkable insecticidal activity against *T. castaneum*.

The present results clearly demonstrate that both the chloroform and methanol extractives from various parts of *A. augusta* have significant insecticidal activities. These results are in agreement with similar works of Krishnamurti and Rao (1944), Su et al. (1972), Sangapa (1977) and Rao et al. (2010). Abdullah et al. (2011) assessed the mortality and repellency of the chloroform extracts of different parts of *Urena sinuata* on *T. castaneum* adults.

Conclusion

A perusal of the data reveal that *A. augusta* extracts can be used as insecticidal compounds in the grain and cereal stores to manage the population of *T. castaneum*. The results also seem to be encouraging when there is a greater need for environment-friendly pesticides than ever before. The overall assessment of toxicity of *A. augusta* extracts are very much promising and their efficacy on stored grain pests might have future to be used as a control agent or tool. It may open its possibility as a control agent for the insect pests as well. However, much more comprehensive investigation is needed in this area.

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