Formosan Entomologist
Journal Homepage: entsocjournal.yabee.com.tw

Ovipositional Preference of the Melon Fly, Bactrocera cucurbitae Coquillet (Diptera : Tephritidae) (II): Analysis of Extracted Chemicals from Fruits of the Muskmelon【Research report】

瓜實蠅產卵之偏好性(II)：洋香瓜果實主成份之萃取與分析【研究報告】

Feng-Ming Lu*
呂鳳鳴*

*通訊作者E-mail :

Received: 2001/12/07 Accepted: 2002/05/17 Available online: 2002/06/01

Abstract

To identify the different kinds of chemicals that can be extracted from muskmelon, three extractive methods were used: headspace extraction, Likens-Nickerson extraction, and vacuum distillation extraction. From bioassaying the ovipositional attraction of each chemical to the melon fly (Bactrocera cucurbitae Coquillet), the more-attractive chemicals included ethyl propanoate, ethyl butyrate, isobutyl acetate, ethyl 2-mercaptopropionate, ethyl acetate and butyl acetate. Those can be mixed to produce an artificial ovipositional attractant.

摘要

將成熟洋香瓜(Cucumis melo)之果實以三種低溫萃取法：上部空間吸附法(headspace absorption extraction) 、蒸氣蒸餾溶劑萃取法(Likens-Nickerson extraction)及真空蒸餾法(vacuum distillation extraction)，分別萃取其果實中所含揮發性重要成份，加以分析並比較其差異性。將重要成份經生物檢定比較其對瓜實蠅(Bactrocera cucurbitae Coq.) 之產卵誘引性。經篩選出丙酸乙酯(ethyl propanoate) 、丁酸乙酯(ethyl butyrate) 、乙酸異丁酯(isobutyl acetate)及2-硫基丙酸乙酯(ethyl 2-mercaptopropionate)為誘卵性較佳者，而乙酸乙酯(ethyl acetate)與乙酸丁酯(butyl acetate)等次之。期配製出可誘引瓜實蠅產卵之人工產卵誘引劑，而利用於防治技術。

Key words: muskmelon, extract, Bactrocera cucurbitae Coquillet, ovipositional attractants.

關鍵詞: 洋香瓜、萃取、瓜實蠅、產卵誘引劑

Full Text: PDF(0.08 MB)

下載其它卷期全文 Browse all articles in archive: http://entsocjournal.yabee.com.tw

台灣昆蟲 22: 163-170 (2002)
Formosan Entomol. 22: 163-170 (2002)

瓜實蠅產卵之偏好性(II)：洋香瓜果實主成份之萃取與分析

呂鳳鳴* 鳳山熱帶園藝試驗分所 高雄縣鳳山市文山路園藝巷四號

摘 要

將成熟洋香瓜(*Cucumis melo*)之果實以三種低溫萃取法：上部空間吸附法(headspace absorption extraction)、蒸氣蒸餾溶劑萃取法(Likens-Nickerson extraction)及真空蒸餾法(vacuum distillation extraction)，分別萃取其果實中所含揮發性重要成份，加以分析並比較其差異性。將重要成份經生物檢定比較其對瓜實蠅(*Bactrocera cucurbitae* Coq.)之產卵誘引性。經篩選出丙酸乙酯(ethyl propanoate)、丁酸乙酯(ethyl butyrate)、乙酸異丁酯(isobutyl acetate)及2-硫基丙酸乙酯(ethyl 2-mercaptopropionate)為誘卵性較佳者，而乙酸乙酯(ethyl acetate)與乙酸丁酯(butyl acetate)等次之。期配製出可誘引瓜實蠅產卵之人工產卵誘引劑，而利用於防治技術。

關鍵詞：洋香瓜、萃取、瓜實蠅、產卵誘引劑。

前 言

瓜實蠅(*Bactrocera cucurbitae* Coquillet)為台灣葫蘆科作物之重要經濟性害蟲(Fang and Chang, 1984)，其雌蟲以產卵管產卵於作物之果實內，使果實外觀受損，因而影響商品價值；且由卵孵化後之幼蟲在果肉內蛀食，極易形成爛果，因此對作物之產量影響甚鉅。目前一般多用化學藥劑之施用、滅雄法(Steiner *et al*., 1944; Keiser, *et al*., 1973; Chu and Yeh, 1987; Liu and Lin, 1992)或套袋(Wen, 1988; Fang, 1989)等防治法來處理。近年來漸加強誘引劑方面之研究，最早在1957年Barthel *et al*.等找出苯甲基丙酮(benzylacetone)及茴香丙酮(anisylacetone)為有效的瓜實蠅人工合成誘引劑，且發展出衍生物(derivative)如克蠅(Cue-lure)等。國內劉1989亦篩選出克蠅為最有效之引誘劑；但其僅可誘到雄蟲。Jacobson 1971提出8種直鏈的九烯醇乙酸酯(nonenyl acetate)可對瓜實蠅雌蟲有誘引效果，尤其是反-6-九烯醇乙酸酯(trans-6-nonen-1-01-acetate(31))之誘引效果最強；但田間應用時可誘到之雌蟲數並不多。Keiser等1973年亦以其在室內做瓜實蠅之誘引試驗，雖然可誘到卵粒，但其具很強之薰蒸性質(fumigant properties)，常使卵變形而孵化率降低(Steiner *et al*., 1965)，因對卵有毒性，故不准用於田間(Voaden *et al*.,

*論文聯繫人

1984)。劉與張 1995 及劉與陳 1995 發展食物誘引劑(food attractants)方面之研究，食物誘引劑雖然可一併誘集雄、雌蟲，而應用時必須添加殺蟲劑，故極易造成環境污染之問題。黃與顏 1998 進行瓜實蠅性費洛蒙(sex pheromone)方面之研究，尚未有完整之報告。為減低瓜實蠅對經濟性作物之為害，台灣目前以誘集雄蟲之滅雄法在田間普遍應用，然以滅雄處理來誘殺雄蟲，由誘集蟲數看來，其確可降低田間蟲口密度，在推廣上可發揮很大之功效。但是否可確定誘集到之雄蟲是在未與雌蟲交尾前呢？若是田間仍留有許多具交尾能力的雄蟲，則田間雌蟲仍具高度之危害力，以致防治效果停滯不前(Chu, 1996)，故探討可誘引瓜實蠅雌蟲產卵之物質，呂 1997 由多種經濟性寄主作物中篩選出洋香瓜之誘卵性最佳，本研究擬繼續探討其萃取物之主要成分，以人工調製之方法找出適當比例與濃度之混合液，期能直接誘集雌蟲產卵，消耗卵粒，以減少田間蟲口密度及其子代數，故應深具防治之潛力。

材料與方法

一、供試蟲之飼育

瓜實蠅幼蟲以人工飼料(Liu and Shiao, 1984)飼育，老熟幼蟲置入底部有木屑之桶內，化蛹後收集蛹體，放入養蟲箱(45 ×45 × 45 cm)，每箱約 2000 個蛹。待成蟲羽化後即以成蟲飼料(Liu and Shiao, 1985; Liu and Shiao, 1986)及洋菜塊(洋菜：水 = 1：100)在室內飼育，並收集卵粒於幼蟲人工飼料盤上繼續飼育；並不定時引入田間野生種混養，以維持供試蟲之生物特性。

二、不同萃取法各萃取物之比較

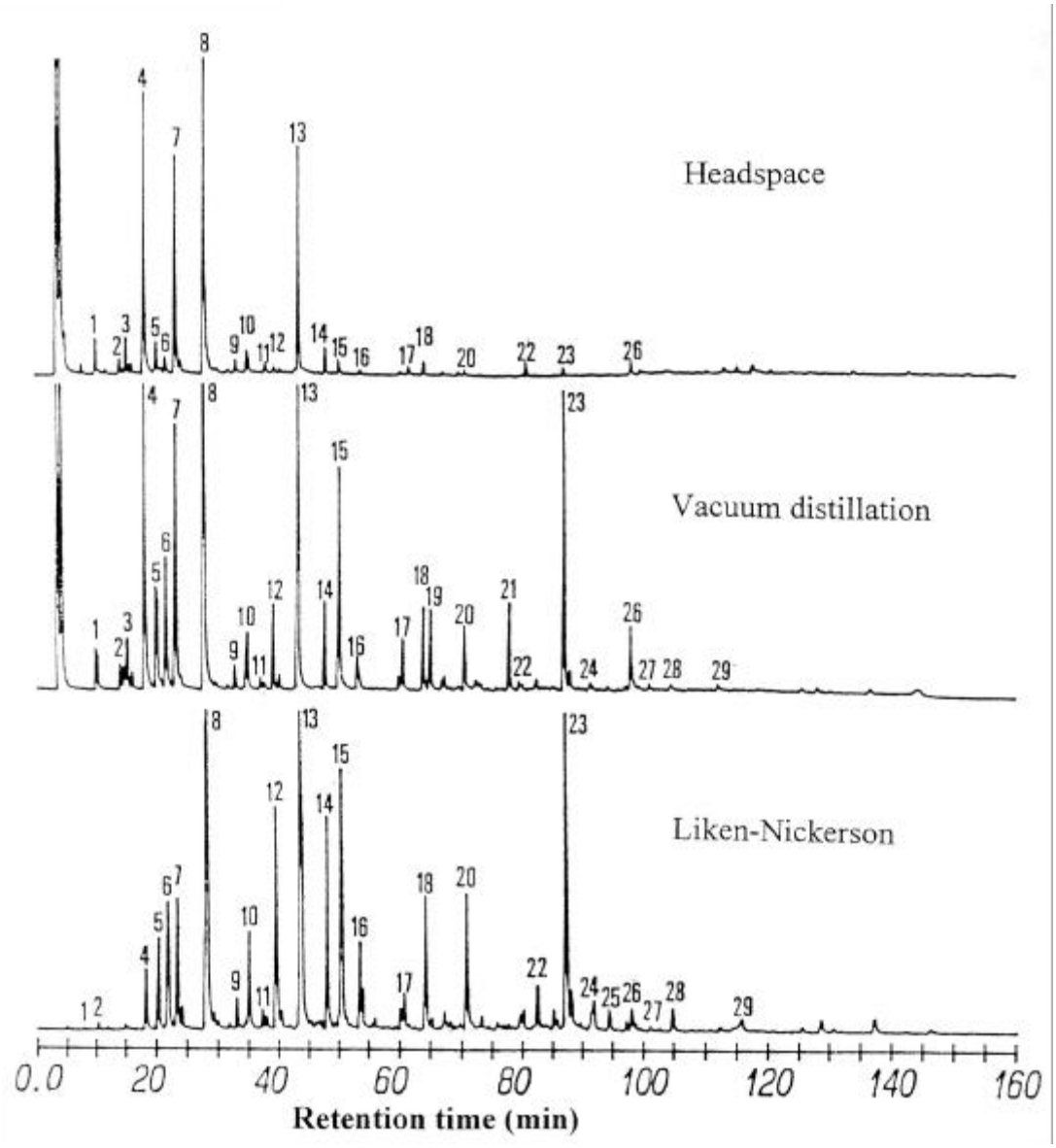
每次以誘卵性最好之洋香瓜(*Cucumis melo* L. var. *reticulatus* Naud. (Lu,1997)熟果 800g 切碎後加入適量之水，分別置入上部空間吸附法(headspace absorption extraction)、真空蒸餾法(vacuum distillation extraction)及蒸氣蒸餾溶劑萃取法(Likens-Nickerson extraction)等三種萃取裝置(Wu, 1987)中，以 40℃水浴法抽取 2~8 小時，使瓜果內揮發性成分漸漸釋出。並將收集物以溶劑(ether/pentane = 1：1)沖洗之，以無水硫酸鈉(sodium sulfate, anhydrous)除去水份後進行濃縮。將三種萃取方法分別收集到之濃縮液，每次以 0.3μℓ 打入氣相層析儀(GC)及氣相層析質譜儀(GC-MS)，進行萃取物之定性分析並加以比較。

三、生物檢定比較

將塑膠誘卵器(直徑 13 cm×長 7 cm)之表面，以針孔平均(1 × 1 cm)穿刺 200 個洞，供做瓜實蠅雌蟲產卵之用。將萃取出之各種化合物，每組隨機選取 6 種成分，每次以 2mℓ 放在有小棉花盒之誘卵器中，再將誘卵器放入六角形養蟲箱(60 × 60 × 60 cm)。每箱內有 2000 隻羽化後 15 天達產卵盛期之瓜實蠅成蟲(雌：雄＝1：1)。置放 1 天後，收取各誘卵器中之卵粒，計算並記錄其卵數，每組各十重複。比較各成份之誘卵性，以為調製產卵誘引劑之參考。

結　果

洋香瓜熟果以不同萃取法萃取之揮發性化合物之氣相層析圖各有不同之差異(圖一)。三種萃取法萃取洋香瓜果實經分析與鑑定共獲得二十九種化合物，而其中上部空間吸附法



圖一　不同萃取法萃取洋香瓜果實中揮發性化合物之氣相層析圖。

Fig. 1.　GC chromatography of volatiles of fruits of muskmelon using different extractive methods.

可得到二十二種成份化合物，真空蒸餾法可得到二十八種成份化合物，蒸氣蒸餾溶劑萃取法可得到二十六種成份化合物。在 29 種化合物中，其中酯類約占 37.93%，醇類與烯類各占 17.24%次之，尚有酸約 10.34%，其餘如苯、烷類等比例更低(表一)。

萃取成分中除了四種為未知成份外，其餘種類經分組誘卵之結果見表二。每次每個誘卵器平均卵數大於 100 粒者如丙酸乙酯(ethyl propanoate)、丁酸乙酯(ethyl butyrate)、乙

表一　不同萃取方法萃取洋香瓜果實中之重要成份

Table 1. Volatile components of muskmelon using different extractive methods

Peak no.	Component	Extracts [2]		
		HS	VD	LN
1[1]	Ethyl formate	+	+	+
2	Ethyl acetate	+	+	+
3	Ethyl propanoate	+	+	—
4	Butyl acetate	+	+	+
5	Ethyl butyrate	+	+	+
6	Unknown	+	+	+
7	Isobutyl acetate	+	+	+
8	1-Pentanol	+	+	+
9	Isoamyl acetate	+	+	+
10	4-Decene	+	+	+
11	Unknown	+	+	+
12	Ethyl hexanoate	+	+	+
13	1-Pentene	+	+	+
14	cis-3-Hexen-1-yl acetate	+	+	+
15	1-Decanol	+	+	+
16	2-Penten-1-01	+	+	+
17	Ethyl 2-mercaptopropionate	+	+	+
18	n-1-1-Octene	+	+	+
19	Hexanoic acid	—	+	—
20	Octane	+	+	+
21	Benzyl acetone	—	+	—
22	1,6-Heptatadiene	+	+	+
23	Acetic acid	+	+	+
24	Cadine	—	+	+
25	Unknown	—	—	+
26	Dodecanoic acid	+	+	+
27	Unknown	—	+	+
28	Benzyl alcohol	—	+	+
29	Benzene	—	+	+

1) Peak numbers refer to Fig. 1.

2) Different extractive methods: HS, headspace; VD, vacuum distillation; LN, Likens-Nickerson. +: component present; —: component absent.

酸異丁酯(isobutyl acetate)及 2-硫基丙酸乙酯(ethyl-2-mercaptopropionate)等之誘卵性較佳；另如乙酸乙酯(ethyl acetate)、乙酸丁酯(butyl acetate)等則次之，其餘成份則更次之(表二)。

討　論

不同品種之洋香瓜，其所含成份及比例雖略有不同，如 Kemp *et al*. 1973 萃取 *Cucumis melo* L. var. *reticulatus* Naud. 之重要成分，Yabumoto *et al*., 1978. 萃取洋香瓜四種品種：PMR 45、Top Mark、Honeydew 及 Crenshaw 等，Horvat and Senter, 1987 萃取 *Cucumis melo* cv. Saticoy, Wyllie *et al*., 1990 研究 *Cucumis melo* cv. Golden crispy 等之萃取成分，其中乙酸乙酯(ethyl acetate)、丙酸乙酯(ethyl

表二　各重要萃取成份對瓜實蠅產卵之誘引性比較

Table 2. Compare the ovipositional attraction of different chemicals to melon flies

No. Chemicals	Avg. no. of eggs /trap				
	I	II	III	IV	V
1. Ethyl formate	11.5				
2. Ethyl acetate	75.0[2)]				
3. Ethyl propanoate	102.2[1)]				
4. Butyl acetate	98.4[2)]				
5. Ethyl butyrate		450.1[1)]			1496.9[1)]
6. Unknown					
7. Isobutyl acetate	733.7[1)]	782.7[1)]			1260.4[1)]
8. 1-Pentanol			0.4		
9. Isoamyl acetate	17.2				
10. 4-Decene				1.5	
11. Unknown					
12. Ethyl hexanoate			12		7.7
13. 1-Pentene		11.3			
14. cis-3-Hexen-1-yl acetate			2.4		
15. 1-Decanol			15.4		
16. 2-Penten-1-01				1.3	
17. Ethyl 2-mercaptopropionate				494.7[1)]	82.8[2)]
18. n-1-1-Octene			3.3		
19. Hexanoic acid					0.01
20. Octane			1.5		
21. Benzyl acetone				47.7	
22. 1,6-Heptatadiene				0.3	
23. Acetic acid		5			
24. Cadine (Naphthalenc)					0
25.Unknown					
26. Dodecanoic acid				1.1	
27. Unknown					
28. Benzal alcohol		0.9			
29. Benzene		4.6			

1) Avg. no. of eggs/trap ＞100.

2) Avg. no. of eggs/trap ＞ 50.

propanoate)、乙酸丁酯(butyl acetate)、乙酸異丁酯(isobutyl acetate)、己酸乙酯(ethyl hexanoate)、乙酸順-3-己烯-1-酯(cis-3-hexen-1-yl acetate)等，與台灣洋香瓜之萃取有相似種類，而誘卵性較佳之各成分(表二)，其性狀均含水果香氣。每種萃取成份需再作生物檢定、比例與濃度之調製、田間測試等工作才能繼續加以研發。另因瓜實蠅產卵之偏好，隨寄主果實之種類、大小、成熟度等之差異而各有不同。 如加強誘集雌蟲及卵之效果，應可減少田間果實之受害程度；但在田間應用前應徹底了解並配合適當時機及誘蟲色片(color traps)之利用(Liu and Chang, 1995 及 Lu, 1997)，才可加強防治之效果。

誌　　謝

感謝新竹食品工業發展研究所 吳淳美博士及劉素娥小姐之協助，使分析及鑑定工作得以順利進行。

引用文獻

Barthel, W. F., N. Green, I. Keiser, and L. F. Steiner. 1957. Anisylacetone synthetic attractant for male melon fly. Science 126: 654.

Chu, Y. I., and W. Y. Yeh. 1987. The attractiveness of methyl eugenol of the melon fly in Taiwan. Plant Prot. Bull. 29: 81-84 (in Chinese).

Chu, Y. I. 1996. Some consideration in practical use of insect attractants. Taiwan Agric. Res. Inst. Spec. Publ. No. 57: 117-132.

Fang, M. N., and C. P. Chang. 1984. The injury and seasonal occurrence of melon fly, *Dacus cucurbitae* Coquillett, in Taiwan. (Trypetidae, Diptera). Plant Prot. Bull. 26: 241-248 (in Chinese).

Fang, M. N. 1989. The damage prevention against melon fly by bagging method. Chinese Entomol. Spec. Publ. No. 4: 130-143 (in Chinese).

Hwang, J. S., and Y. P. Yen. 1998. Studies on sex pheromones and attractants for the melon fly, *Bactrocera cucurbitae* and the Oriental fruit fly, *Bactrocera dorsalis* and the effects of temperature on attractiveness of methyl eugenol and cuelure. Proceedings of the Symposium on Control of Techniques of Fruit Flies in Taiwan, Spec. Publ.: 149-172 (in Chinese).

Horvat, R. J., and S. D. Senter. 1987. Identification of additional volatile compounds from cantaloupe. J. Food Sci. 52: 1097-1098.

Jacobson, M. 1971. Synthetic nonenyl acetates as attractants for female melon fly. J. Med. Chem. 14: 236-239.

Keiser, I., R. M. Kobayashi, D. H. Miyashita, M. Jacohson, E. J. Harris, and D. L. Chambers. 1973. Trans-6-nonen-1-01 acetate: an ovipositional attractant and stimulant of the melon fly. J. Econ. Entomol. 66: 1355-1357.

Kemp, T. R., D. E. Knavel, and L. P. Stoltz. 1973. Volatile *Cucumis melo* components: identification of additional compounds and effects of storage conditions. Phytochemistry 12: 2921-2924.

Liu, Y. C. 1989. Development of attractants for controlling the melon fly, *Dacus cucurbitae* Coquillett, in Taiwan. Chinese J. Entomol. Spec. Publ. No. 4: 130-143 (in Chinese).

Liu, Y. C., and C. Y. Chang. 1995. Selection of food attractants to the melon fly, *Dacus cucurbitae* Coquillett and supplementary effect of yellow insect adhesive paper. Chinese J. Entomol. 15: 35-46.

Liu, Y. C, and S. K. Chen. 1995. Development of food attractants for melon fly, *Dacus cucurbitae* Coquillett. Plant. Prot. Bull. 37:

189-199 (in Chinese).

Liu, Y. C., and J. S. Lin. 1992. The attractiveness of 10% - MC to melon fly, *Dacus cucurbitae* Coquillett. Plant. Prot. Bull. 34: 307-315 (in Chinese).

Liu, Y. C., and T. Y. Shiao. 1984. Mass production of the melon fly *Dacus cucurbitae* Coquillett. Ⅰ. Mass rearing technique of the larvae. Bull. Soc. Entomol. NCHU 17: 1-13 (in Chinese).

Liu, Y. C., and T. Y. Shiao. 1985. Mass production of the melon fly *Dacus cucurbitae* Coquillett. Ⅱ. Mass rearing technique of the eggs. Bull. Soc. Entomol. NCHU 18: 37-47 (in Chinese).

Liu, Y. C., and T. Y. Shiao. 1986. Mass production of the melon fly *Dacus cucurbitae* Coquillett. Ⅲ. Mass production technique of adults and pupae. Bull. Soc. Entomol. NCHU 19: 45-56 (in Chinese).

Lu, F. M. 1997. Ovipositional Preference of the melon fly, *Bactrocera cucurbitae* Coq. (Ⅰ) Tests of host plant and color. Chinese J. Entomol. 17: 237-243 (in Chinese).

Steiner, L. F., W. C. Mitchell, and D. H. Miyashita. 1944. New synthetic lures for the male melon fly. Science 131: 1044-1045.

Steiner, L. F., E. J. Harris, W. C. Mitchell, M. S. Fujimoto, and L. D. Christenson. 1965. Melon fly eradication by overflooding with sterile flies. J. Econ. Entomol. 58: 519-522.

Voaden, D. J., M. Schwarz, R. M. Waters, M. Jacobson, and I. Keiser. 1984. Synthesis and biological evaluation of candidate nonenyl acetatesas melon fly ovipositional attractants. J. Agric. Food. Chem. 32: 769-773.

Wen, H. C. 1988. Preliminary stady on the control of melon fly in the field. J. Agric. Res. China 37: 220-224 (in Chinese).

Wu, C. M. 1987. Food flavor chemistry and technology. Food Industry Research and Development Institute, Special publ. 347 pp.

Wyllie, S. G., and D. N. Leach. 1990. Aroma volatiles of *Cucumis melo* cv. Golden crispy. J. Agric. Food Chem. 38: 2042-2044.

Yabumoto, K., M. Yamaguchi, and W. G. Jennings. 1978. Production of volatile compounds by muskmelon, *Cucumis melo*. Food Chem.: 7-16.

收件日期：2001 年 12 月 7 日
接受日期：2002 年 5 月 17 日

Ovipositional Preference of the Melon Fly, *Bactrocera cucurbitae* Coquillet (Diptera : Tephritidae) (Ⅱ): Analysis of Extracted Chemicals from Fruits of the Muskmelon

Feng-Ming Lu* Department of Plant Protection, Fengshan Tropical Horticultural Experiment Station, Taiwan, R. O. C.

ABSTRACT

To identify the different kinds of chemicals that can be extracted from muskmelon, three extractive methods were used: headspace extraction, Likens-Nickerson extraction, and vacuum distillation extraction. From bioassaying the ovipositional attraction of each chemical to the melon fly (*Bactrocera cucurbitae* Coquillet), the more-attractive chemicals included ethyl propanoate, ethyl butyrate, isobutyl acetate, ethyl 2-mercapto-propionate, ethyl acetate and butyl acetate. Those can be mixed to produce an artificial ovipositional attractant.

Key words: muskmelon, extract, *Bactrocera cucurbitae* Coquillet, ovipositional attractants.