Mj. Int. J. Sci. Tech., **2007**, *01(02)*, 222-228

Maejo International

Journal of Science and Technology

ISSN 1905-7873

Available online at www.mijst.mju.ac.th

Short Communication

Fatty acid content and antioxidant activity of Thai bananas

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Received: 17 October 2007 / Accepted: 6 December 2007 / Published: 7 December 2007

Abstract: The aril extracts of three Thai banana varieties, namely "Kluai Khai"(KK), "Kluai Namwa"(KN) and "Kluai Hom"(KH) were analysed by gas chromatography and mass spectrometry (GC-MS). GC-MS data were used to identify 5 methyl esters of each banana extract after transesterification. The most prominent components found in KK, KN and KH were hexadecanoic acid methyl ester (43.17, 29.18, 30.57 % respectively), 9, 12, 15-octadecatrienoic acid methyl ester (35.93, 30.46, 39.68 % respectively), 9, 12-octadecadienoic acid methyl ester (14.35, 36.10, 21.82 % respectively), 9-hexadecanoic acid methyl ester (3.76, 3.34, 3.32 % respectively) and octadecanoic acid methyl ester (2.79, 0.92, 4.60 % respectively). The antioxidant activity of the crude oils was evaluated using DPPH method.

Key words: banana, fatty acids, antioxidant

Introduction

The banana is one of the most popular fruits in the world. A member of the genus *Musa* (part of the family *Musaceae*), they are considered to be derived from the wild species *Musa acuminata* and *Musa balbisiana* [1]. It is believed that there are almost 1000 varieties of bananas in the world, subdivided into 50 groups [2]. The origin of bananas is placed in South-east Asia, in the jungles of Malaysia, Indonesia and Philippines, where so many varieties of wild bananas still grow at present. In Thailand, there are three most popular varieties (among several to choose from), viz. "Kluai Khai" (KK), "Kluai Namwa" (KN) and "Kluai Hom" (KH). Bananas have many beneficial nutritional properties. They are a good source of vitamins C, B6 and A [3]. Bananas have a high content of carbohydrates and fibre, while they are low in protein [4]. They are also rich in potassium [5]. Several papers have reported the chemical content of volatiles of banana [6-9]. However, so far as we know, only one study has been carried out on the fatty acid composition of the fixed oils obtained from dried and fresh bananas [10]. Moreover, no study has been carried out on Thai banana varieties, especially the "Kluai Khai" (KK), "Kluai Namwa" (KN) and "Kluai Hom" (KH). We thus report here the fatty acid analysis result of "Kluai Khai" (KK), "Kluai Namwa" (KN) and "Kluai Hom" (KH) bananas by GC–MS and also the antioxidant activity of the obtained crude oil using DPPH method.

Materials and Methods

Fruits

"Kluai Khai" (KK), "Kluai Namwa" (KN) and "Kluai Hom" (KH) bananas were obtained from a local market in the provinces of Kampangpech (for KK), Chiang Mai (for KN) and Nakornpratom (for KH), Thailand, in May 2007.

Extraction

The aril (700 g each) of the bananas (KK, KN and KH) was separately extracted with hexane (2×250 ml). The extract was dried over Na_2SO_4 and evaporated to give 1.27 % (KK), 1.31 % (KN) and 1.24 % (KH) yield of an oil.

Transesterification [11]

One g of each oil in benzene (20 ml) and methanol (20 ml) was added with a small amount of sodium (~0.05 g) and left overnight. The solution was extracted by dichloromethane, which was washed with water several times. The dichloromethane layer was evaporated to give ~ 2 ml of oil which was a mixture of the methyl esters. The FT-IR spectra (run with a Perkin Elmer System 2000) were used to confirm the ester functional group of the oils.

GC-MS Analysis

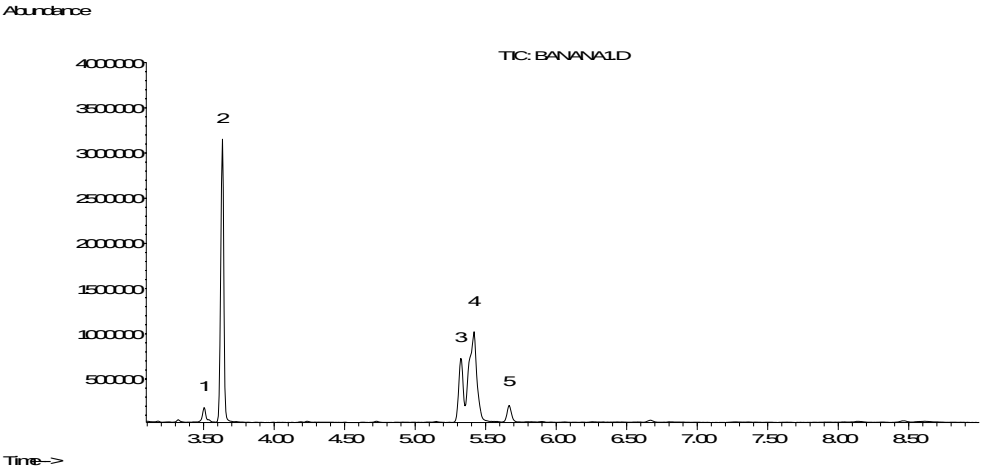
The oils obtained from the transesterification reaction were analysed by GC–MS [performed on a Agilent 6890(GC)/HP 5975(MS)]. Separation was achieved using H_2 as carrier gas (ca.1 ml/min) with a fused silica capillary column (DB-5) 30 m long, with 0.25 mm i.d. and 0.25 μm film thickness. Injector and detector temperatures were 250 °C and 260 °C, respectively; with oven temperature programme: 1 min isothermal at 40 °C, then at 10 °C/min to 260 °C (5 min isothermal). The MS instrument was operated in full scan and electron impact ionization mode (70 eV).

Antioxidant activity, DPPH method [12]

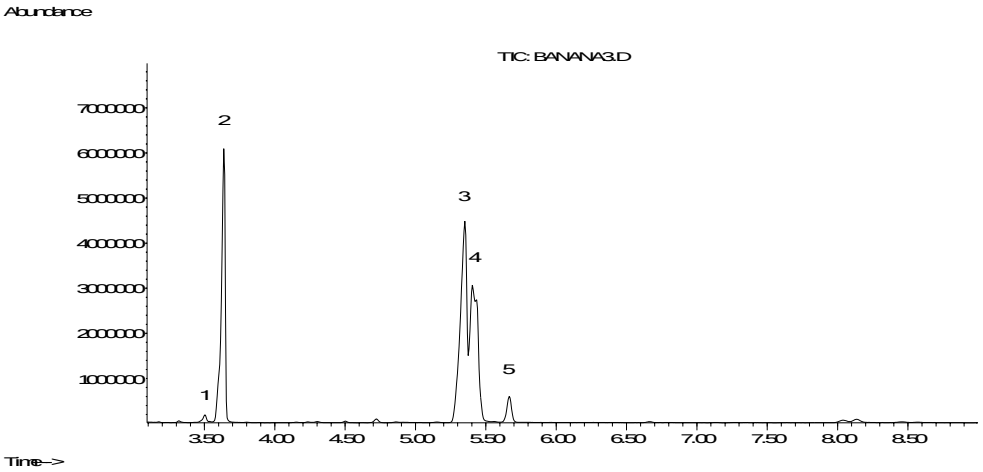
The oil was dissolved in methanol to give a solution of 100 ppm concentration. This sample was further diluted to 7 concentrations (two-fold dilutions). Each concentration was tested in triplicate. A portion of sample solution (1 ml) was mixed with an equal volume of 0.2 mM DPPH (1,1-diphenyl-2-picrylhydrazyl) in absolute methanol and allowed to stand at room temperature for 30 min. The absorbance (A) was then measured at 514.5 nm (Hitachi U-2001 UV-spectrophotometer). Vitamin E was tested in the same system as a positive control. The results were expressed as percent inhibition calculated from the equation: % inhibition = $[(A_{control} - A_{sample})/ A_{control}] \times 100$. IC_{50} value (inhibition concentration of sample required to scavenge DPPH radical by 50 %) was obtained by linear regression analysis of the dose-response curve plot (% inhibition versus concentration).

Results and Discussion

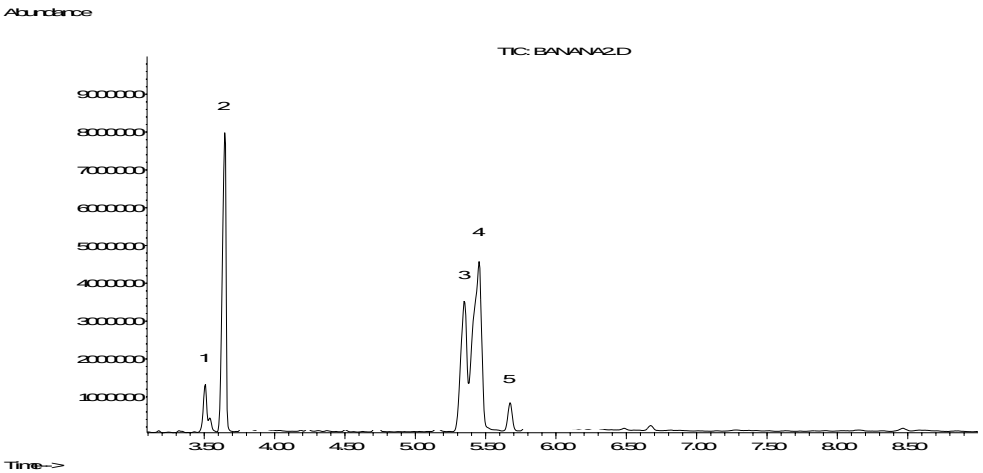
A typical analysis result of the transesterified oils of KK, KN and KH bananas are shown in Figure 1. Compounds corresponding to the peaks are listed in Table 1.



KK



KN



KH

Figure 1. Gas chromatograms of the transesterified oils of Thai bananas (KK, KN and KH)

Table 1. Components in the transesterified oils of aril of Thai bananas (KK, KN and KH)

Peak No.	Compounds	RA[a] %			MW[b]	Quality %[c]	Identification[d]
		KK	KN	KH			
1	9-Hexadecenoic acid methyl ester (palmitoleic acid methyl ester)	2.79	0.92	4.60	268	99	1, 2
2	Hexadecanoic acid methyl ester (palmitic acid methyl ester)	43.17	29.18	30.57	270	99	1, 2
3	9, 12-Octadecadienoic acid methyl ester (linoleic acid methyl ester)	14.35	36.10	21.82	294	99	1, 2
4	9, 12, 15-Octadecatrienoic acid methyl ester (linolenic acid methyl ester)	35.93	30.46	39.68	292	99	1, 2
5	Octadecanoic acid methyl ester (stearic acid methyl ester)	3.76	3.34	3.32	298	99	1, 2

[a] RA: relative area (peak area relative to total peak area)

[b] molecular weight from GC-MS (EI) data

[c] MS quality compared with database

[d] 1, based on comparison of mass spectra from NIST library; 2, based on comparison of mass spectra from Wiley library

It is clear from Table 1 that in each of the banana oils after transesterification, five prominent peaks of methyl esters are identified. In these, there appears the presence of two saturated methyl esters (peaks No. 2 and 5) and three unsaturated methyl esters (peaks No. 1, 3 and 4). Thus, the major fatty acid components found in KK, KN and KH are hexadecanoic (palmitic) acid (43.17, 29.18, 30.57 % respectively), 9, 12, 15-octadecatrienoic (linolenic) acid (35.93, 30.46, 39.68 % respectively), and 9, 12-octadecadienoic (linoleic) acid (14.35, 36.10, 21.82 % respectively), and the minor fatty acids are octadecanoic (stearic) acid (3.76, 3.34, 3.32 % respectively) and 9-hexadecenoic (palmitoleic) acid (2.79, 0.92, 4.60 % respectively). These results were similar to those found in the previous study [10]. It was found therefore that KK, KN and KH bananas contain more unsaturated fatty acids than saturated ones and also each variety provides different amounts of each fatty acid, although their amounts were only slightly different. Notably, these banana fixed oils were all found to contain

unusually high amounts of linoleic acid, although, similar to the previous finding [10], no oleic acid was detected in any of the oils studied.

The antioxidant activity of the banana oils before transesterification was evaluated using DPPH method and the results are shown in Table 2.

Table 2. Antioxidant activity of banana oils using DPPH method

Bananas	KK	KN	KH
IC_{50} (μg/ml)*	90	73	81

* IC_{50} of Vitamin E = 12.55 ppm

It was clear that the banana oils of KK, KN and KH showed moderate antioxidant activities compared to vitamin E when assayed by DPPH.

Acknowledgements

The authors are grateful to the Biology Department of Maejo University for GC/MS facilities. They would also like to thank the Chemistry Department of Maejo University for the undergraduate grant to R. M., a final year chemistry student.

References

1. K. Kayisu, L. F. Hood, and P. J. Vansoest, "Characterization of starch and fiber of banana fruit", *J. Food Sci.*, **1981**, *46*, 1885-90.
2. F. Lheureux, N. Laboureau, E. Muller, B. E. L. Lockhart, and M. L. Iskra-Caruana, "Molecular characterization of banana streak acuminata Vietnam virus isolated from Musa acuminata siamea (banana cultivar)", *Archives of Virology*, **2007**, *152*, 1409-1416.
3. M. Hagg, S. Ylikoski, and J. Kumpulainen, "Vitamin C content in fruits and berries consumed in Finland", *J. Food Comp. Anal.*, **1995**, *8*, 12-20.
4. E. T. Happi, R. H. Andrianaivo, B. Wathelet, J. T. Tchango, and M. Paquot, "Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels", *Food Chem.*, **2007**, *103*, 590-600.
5. S. Agrawal, R. K. Patel, S. D. Pandey, "Influence of higher levels of nitrogen and potassium on growth and yield potential of in-vitro Banana (cv. Robusta)", *Mysore J. Agri. Sci.*, **1998**, *32*, 275-

280.

6. H. Shiota, "New esteric components in the volatiles of banana fruit *(Musa sapientum* L.) ", *J. Agric. Food Chem.,* **1993**, *41,* 2056-2062.
7. J. M. F. Nogueira, P. J. P. Fernandes, and A. M. D. Nascimento, "Composition of volatiles of banana cultivars from Madeira Island", *Phytochem. Anal*., **2003**, *14*, 87-90.
8. J. Wabg, Y. Z. Li, R. R. Chen, J. Y. Bao, and G. M. Yang, "Comparison of volatiles of banana powder dehydrated by vacuum belt drying, freeze-drying and air-drying", *Food Chem*., **2007**, *104*, 1516-1521.
9. J. A. Pino, A. Ortega, R. Marbot, and J. Aguero, "Volatile components of banana fruit (*musa sapientum L*.) "Indio" for Cuba" *J. Essent. Oil. Res*., **2003,** *15*, 70-71
10. İ. Orhan, Ş. Küsmenoğlu, and B. Şener. "Fatty acid profile of fresh and dried banana (*Musa sapientum* L. var. *cavendishii* Lamb.) Peel Oils", *J. Fac. Pharm. Ankara*., **2002**, *31*, 13-19.
11. W. Phutdhawong, S. Kaewkong, and D. Buddhasukh, "GC-MS analysis of fatty acids in Thai durian aril." *Chiang Mai J. Sci.*, **2005**, *32*, 169-172.
12. W. Phutdhawong, R. Kawaree, S. Sanjaiya, W. Sengpracha, and D. Buddhasukh, "Microwave-assisted isolation of essential oil of *Cinnamomum iners* Reinw. ex Bl.: comparison with conventional hydrodistillation", *Molecules*, **2007**, *12*, 868-877.