Polycyclic Aromatic Hydrocarbons Produced from Grilled and Roasted Sweet Potatoes

〔東京家政大学研究紀要　第31集 (2). p. 27～30, 1991〕

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(Received September 29, 1990)

Introduction

Yearly transition of standardized mortality ratio (in Japan) to a maglinant neoplasms by region of the japanese[1] indicates a recent increase in the maglinant neoplasms of colon and lungs.

One of the causes of this phenomenon is said to be attributable to a variation of their dietary intake and increased ingestion of oils, fats and meats[2] in particular. Reports also says that about 30% out of the maglinant neoplasms are more or less related to their dietary habits.

It is well known that foods cooked with strong heat tends to form cancer-causing substance.

We have, for more than 10 years, been investigating a series of forming processes of Polycyclic Aromatic Hydrocarbons (hereinafter called PAH) represented by carcinogenic Benzo(a) Pyrene (hereinafter called B(a)P) in foods on the market[3)~7)] and of those ascribable to grilling and roasting methods of foods (applied temperature, cooking appliances, etc).[8)~11)]

Although there is a report written by W. Fritz[12] regarding PAH formed in beer malt through roast-drying, but the other reports on PAH produced from heated vegetables are almost unavailable.

Studies made out this time were to check to see how and by what degree would PAH be formed in both flesh and skin parts of sweet potatoes when roasted on hot pebbles and grilled with open-air fire. Results of the studies are now described in this report.

食品衛生学第1研究室

Experiment

Made experiment according to the previous report.[10]

Samples and preparations:

Sweet potatoes were sampled from those on the market in Tokyo during the period of February, 1987～June, 1988.

Raw sweet potatoes:

Prepared by shredding, 5g of thinly peeled skin part and 70g of flesh part respectively to be weighed correctly, then dried into a drier (60-70°C) for 5-6 hours.

Roasted sweet potatoes on hot pebbles:

Purchased those already prepared to sell at a market, and correctly weighed 27g of thinly peeled skin part and 100g of finely cut flesh part respectively, then dried as in the manner taken for the raw sweet potatoes.

Grilled sweet potatoes with open-air fire:

Put raw sweet potatoes into open-air fire for grilling until ready to eat, and correctly weighed 14g of peeled skin part and 100g of flesh part respectively, then dried as in the manner taken for the raw sweet potatoes.

Procedure:

Such analytical procedure as Soxhlet extraction, liquid-liquid distributive extraction, Column chromatography and fluorescence measuring was employed as in the manner reported previously[10].

Results

The results of PAH coming from different heating methods applied to sweet potatoes are shown in Table 1 attached herewith.

Discussion

(1) Fig. 1 indicates Fluoranthene spectra detected from skin part of raw sweet potatoes, and Fig. 2 shows Fluorescence spectra of Perylene detected from skin part of grilled sweet potatoes with open-air fire as an instance.

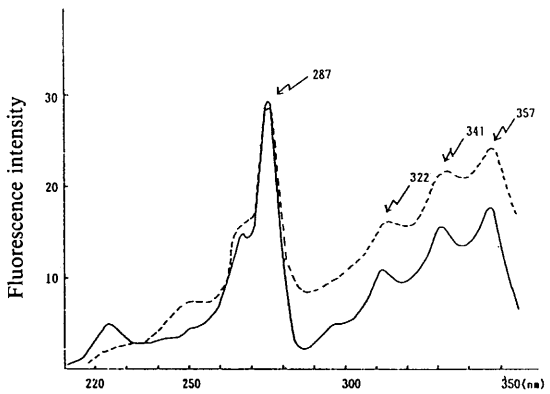

Fig. 1. Fluorescence spectra of Fluoranthene isolated from Sweet potato (Raw)
———Standard Fluoranthene (68.5ppb)
- - - - - - -Sweet potato (Raw)

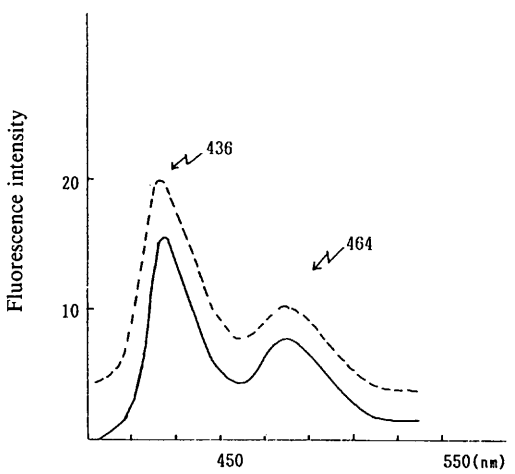

Fig. 2. Fluorescence spectra of Perylene isolated from Sweet potato skin (open-air fire)
———Standard perylene (5ppb)
- - - - - - -Sweet potato skin (open-air fire)

All sorts of PAH showed characteristic fluorescence peak, which falls in line with that of standard PAH.

(2) As shown in the Table 1, those PAHs detected from each sample were 5-10 kinds, total 15 kinds.

1) In the raw sample, except B(a)P, 4 kinds of carcinogenic PAH including Benz(a)anthracene were not detected. Such non-carcinogenic PAHs as Phenanthrene, Perylene and Acenaphthene were also not found both in flesh and skin parts, while other 7 kinds of PAH were detected in those 2 parts or in either of the two.

Studies indicate that total quantity of PAHs detected in skin part was 20 times greater than that in flesh part.

2) In the heated-up sample, all sorts of carcinogenic PAH and 9 kinds of non-carcinogenic PAH except 1-Methyl-Phenanthrene were detected both in flesh and skin parts or in either of the two.

Particularly, there were remarkable quantities of PAH produced in skin part of the sample grilled with open-air fire. They were carcinogenic Benz(a)anthracene, B(a)P and non-carcinogenic Pyrene, Fluoranthene, Phenanthrene and Coronene.

In general PAHs produced in skin part were far greater than those in flesh part, the phenomenon of which was endorsed by the facts that total quantity of PAHs in skin part of the sample grilled with open-air fire was detected 180 times greater than that in flesh part and in skin part of the sample roasted on hot pebbles was 11 times greater than that in flesh part.

In addition, comparing PAHs produced in skin part of the smple grilled with open-air fire with those in the same part of the sample roasted on hot pebbles, it showed 13 times greater amount detected from the latter.

3) Total PAHs detected in flesh part of the raw sample were 0.94ppb, while those in the same part of the sample roasted on hot pebbles and that grilled with open-air fire were 3.34ppb and 2.63ppb respectively, which seems to be reasonably low levels, and as the figure shows, no remarkable difference was in evidence between the two way of grilling and/roasting.

The amount of PAHs produced in flesh part (of heated sweet potatoes) was found to be identical tendency with those produced in such other heated vegetable foods as eggplant, green pepper, onion and corn, of

which we reported previously.[10),11)]

Table 1 Polycyclic Aromatic Hydrocarbons Produced from Grilled and Roasted Sweet Potatoes

	PAH	Raw		Roasted on hot pebbles		Grilled with open-air fire	
		Flesh (ppb)	Skin (ppb)	Flesh (ppb)	Skin (ppb)	Flesh (ppb)	Skin (ppb)
Carcinogénic	Benz(a)anthracene	ND	ND	0.02	0.51	ND	45.42
	Benzo(a)pyrene	0.03	0.40	0.02	0.68	0.15	64.63
	Dibenz(ah)anthracene	ND	ND	ND	0.09	ND	ND
	3-Methylcholanthrene	ND	ND	ND	ND	ND	4.48
	Benzo(e)pyrene	ND	ND	0.03	ND	ND	ND
Non-Carcinogénic	Pyrene	ND	0.62	0.54	ND	ND	64.51
	Fluoranthene	0.80	12.18	0.30	1.81	1.01	35.68
	Anthracene	0.02	ND	0.01	ND	ND	6.38
	Phenanthrene	ND	ND	1.62	29.12	0.58	86.34
	Coronene	0.03	1.13	0.40	3.53	0.67	127.08
	2,3-Benzofluorene	0.06	1.21	ND	ND	ND	2.40
	1-Methylphenanthrene	ND	2.61	ND	ND	ND	ND
	Perylene	ND	ND	ND	0.15	0.03	16.37
	Benzo(k)fluorene	ND	0.01	0.04	0.53	0.12	20.44
	Acenaphthene	ND	ND	ND	ND	0.07	ND
Total		0.94	18.16	3.34	36.42	2.63	470.73

ND: Not detected <0.01ppb

Summary

(1) 5 kinds of such carcinogenic PAH as Benz(a)anthracene, B(a)P, Dibenz (a, h) anthracene, 3-Methylcholanthrene and Benzo(e)pyrene were nearly not detected from eatable flesh part of sweet potatoes roasted on hot pebbles and that grilled with open-air fire.

(2) Higher levels of PAH produced from heated sweet potatoes were Coronene and Phenanthrene both in flesh and skin parts.

(3) Even if skin part of sweet potatoes was scorched black, PAHs produced in flesh part were not in high levels. In other words, PAH intake from eating sweet potatoes either roasted on hot pebbles or grilled with open-air fire, by peeling scorched skins off, ws found to be almost identical with that contained in other foods on the market.

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さつま芋の加熱方法の違いによる多環芳香族炭化水素の生成

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（平成２年９月29日受理）

野菜類の加熱時における多環芳香族炭化水素（以下ＰＡＨと略す）の生成の報告はほとんど見られない．

今回は，野菜の中で，さつま芋を石焼き及びたき火で焼いた際の果肉部と皮部のＰＡＨの生成状況を検討し，その結果が得られたので報告する．

たき火による皮部が最も黒く焦げ，ＰＡＨの検出量も０～127.08 ppb と高かった．しかし，可食部である果肉部からは，Benzo（ａ）pyrene を始めとする発がん性ＰＡＨ及び発がん性のないＰＡＨの検出量は０～1.62 ppb でその10～400分の１と非常に低かった．

この結果より，皮をむいて食べれば，ＰＡＨの取り込み量も，他の市販食品と同じ程度であることがわかった．