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Research Article

Distribution of Benzo (*a*) Pyrene in Frying Oil in the Chinese Market

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Abstract: In this study, the concentrations of benzo (a) pyrene (B(a)p) in frying oil collected in Chinese Market were analyzed. B(a)p was found in samples of different regions, at levels up to 72.37 μg/kg collected from Central China. Variable levels of B(a)P were found in different oil types, ranging from 27.25 to 85.42 μg/kg. The oil used for frying for vegetable foods and for compounded foods showed the minimum and maximum concentrations of B(a)P of 28.56 and 65.94 μg/kg, respectively. The B(*a*)p concentrations of frying oil decreased from 18.05 to 17.50 μg/kg with the reduction rate of 3.05% when the samples were kept in room temperature and no light was evaded after 9 months.

Keywords: Benzo (a) pyrene, Chinese market, distribution, frying oil

INTRODUCTION

Benzo (*a*) pyrene (B(*a*)p) is a recognized strong carcinogen, which consists of five aromatic rings and is also named 3, 4-benzopyrene. It can be found as highly stable contaminants in many foods (Speer *et al*., 1990). In the vegetable oils, the contamination can be attributed to the pollution of environment or raw materials and the inappropriate processing method.

Different maximum tolerable concentrations of B(*a*)p in vegetable oil have been set by diverse organizations in many countries. European Union (EU) has set a legal limit for B(*a*)p in edible oil with 2 μg/kg. Some countries (Spain, Italy, Portugal and Greece) recommended a value of 5 μg/kg for the sum of the eight heavy PAHs (benzo (*a*) anthracene, benzo (*e*) pyrene, benzo (*b*) fluoranthene, benzo (*k*) fluoranthene, benzo (*a*) pyrene, dibenzo (*ah*) anthracene, benzo (*ghi*) perilene and indeno (1, 2, 3-*cd*) pyrene) (Moret *et al*., 2005). In accordance with Hygienic standard for edible vegetable oil of China (GB 2716-2005, 2005), the content of B(*a*)p in edible oil should not exceed 10 μg/kg, revealing a significant gap compared with the international regulations (Li *et al*., 2011). Meanwhile, variable levels of vegetable oil contamination by B(*a*)p have been found in china. Dong *et al*. (2009) reported 0.1-9.3 μg/kg of B(*a*)p in sample of soybean oil in Chinese market, corn oil and sesame oil showed levels of 0.26-7.9 and 0.2-25.5 μg/kg, respectively.

In recent years, the frying oil has attracted more attention in virtue of its potential security issues. It has been revealed that some restaurants and catering enterprises repeatedly use the same frying oil for a long time, which may threaten the public health and even result in cancer. Recent studies on the quality analysis of frying oil have focused on the analysis of oxidation products during the frying process (Uematsu *et al*., 2002; Moreno *et al*., 1999; Gonzaga and Pasquini, 2006). There is little data available for the B(*a*)p in frying oil despite of its importance in Chinese market.

The work was conducted to evaluate the levels of benzo (*a*) pyrene in frying oil available in the Chinese market, meanwhile, the levels of B(*a*)p in frying oil under different storage conditions was estimated and to estimate the potential dietary intake of this contaminant derived from the consumption of frying oils in China (Antonio and Maria, 1996).

MATERIALS AND METHODS

Samples: All samples were collected from street stalls in different regions of China.

Analysis method: The analysis method of benzo (*a*) pyrene was in accordance with the method previous reported (Wang *et al*., 2013).

RESULTS AND DISCUSSION

In this study, 22 samples were acquired in different regions of China with various oil types and fried foods (Table 1). The samples collected covered seven distinct regions of China, seventeen provinces (municipalities) and six different oil varieties with different frying applications.

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Table 1: Overview of frying oil samples collected from Chinese market

Number	City	Respective region	Oil variety	Fried food
1	Baoding	North China	Cottonseed oil	Fried dough sticks
2	Beijing	North China	Blend oil	Radish ball
3	Bengbu	East China	Soybean oil	Fried dough sticks, fried dough twist
4	Canton	South China	Blend oil	Chicken
5	Chengdu	Southwest China	Blend oil	Sausage
6	ChungKing	Southwest China	Salad oil	Vegetable
7	Fuzhou	South China	Salad oil	Meat
8	Haicheng city	Northeast China	Soybean oil	Fish
9	Hengshui	North China	soybean oil	Fish, eggplant
10	Jinan	East China	soybean oil	Meat, vegetable
11	Shenyang	Northeast China	salad oil	Meat
12	ShiJiazhuang	North China	Cottonseed oil	Meat, fish, toon
13	Shuangcheng	Northeast China	Soybean oil	Meat ball
14	Tianjin	North China	Blend oil	Fried dough sticks
15	Ulanqab	North China	Siritch	Rabbit meat, fish
16	Urumqi	Northwest China	Blend oil	Kabap
17	Weihai	East China	Soybean oil	Fish
18	Wuhan	Central China	Rapeseed oil	Chicken
19	Xi'an	Northwest China	Blend oil	Fried dough sticks
20	Xinyang	Central China	Blend oil	Fried dough sticks
21	Yancheng	East China	Salad oil	Fish
22	Zhengzhou	Central China	Blend oil	Meat ball, fried dough sticks

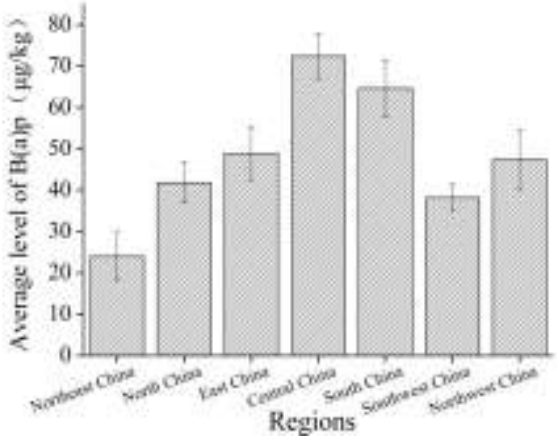

Fig. 1: Average levels of B(*a*)p in frying oil of different regions

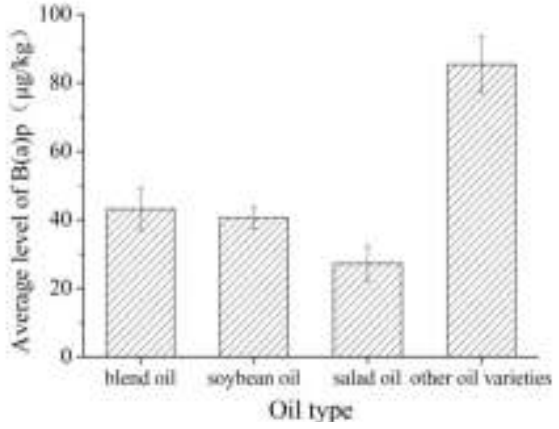

Fig. 2: Average levels of B(*a*)p in frying oil of different oil types

As revealed in Fig. 1, variable levels of B(*a*)P were found in the samples of different regions and 86.36% of samples have exceeded 10 μg/kg regulated by Hygienic standard for edible vegetable oil of China (GB 2716-2005, 2005). Frying oils collected from Northeast China and Central China showed the minimum and maximum concentrations of B(*a*)P of 23.94 and 72.37 μg/kg, respectively; while samples from North China and Southwest China did not present sharply change with concentrations of B(*a*)p varying between 41.86 and 38.18 μg/kg. These relatively higher levels can be attributed to a great deal of factors, for example, excessive repeatedly use of the same oil, over high heating temperature for frying or contaminated oil with B(*a*)P, previously. In brief, it is worried by levels of B(*a*)p in frying oil that have rocketed sky high.

Figure 2 shows the concentrations of B(*a*)p in samples of different oil types. The samples collected consist of soybean oil, salad oil, blend oil and other oil varieties (siritch, cottonseed oil, rapeseed oil). Oils. As can be observed, the minimum level of B(*a*)p was measured in salad oil and B(*a*)p contamination in soybean oil was very similar to those found in blend oil. On the other hand, Levels up to 80 μg/kg of B(*a*)P have been found in other oil varieties, which could be probably attributed to the fact that the refining process and other treatments of crude vegetable oils were not conducted well, therefore, B(*a*)p and other Polycyclic Aromatic Hydrocarbons (PAHs) remain in the final products. A detected contamination of B(*a*)p in sunflower, soybean and virgin olive oils before refining ranging from 17.36 to 65.33 μg/kg has been cited in the literature (Vitor *et al*., 2007).

Figure 3 compares the contends of B(*a*)p in frying oil for different application and the results reveal that the oil used for frying animal foods resulted in a higher B(*a*)p level of 52.35 μg/kg than for vegetable foods with the B(*a*)p concentration of 28.56 μg/kg, but lower than for compounded food with the B(*a*)p content of 65.94 μg/kg. The outcomes found in this study were probably

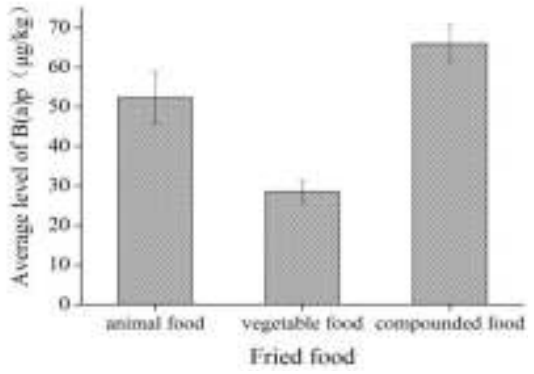

Fig. 3: Average levels of B(*a*)p in frying oil of different fried foods

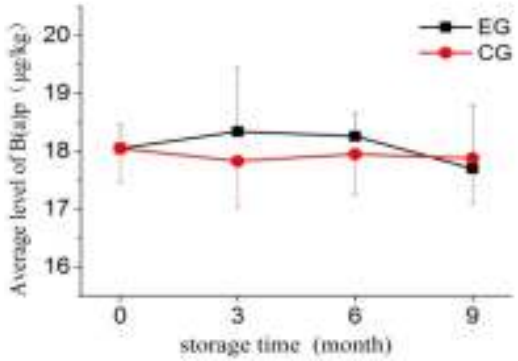

Fig. 4: Average levels of B(*a*)p in frying oil under different storage conditions

because melted fat from the heated animal foods drips into the oil, giving rise to B(*a*)p and relative PAHs. By comparison to vegetable foods, animal foods usually contain more fat and protein, which may lead to series of complex reaction of pyrolysis and thermal condensation and a great amount of PAHs including the B(*a*)p during the frying process for a long time (Uematsu *et al*., 2002). Moreover, a large amount of previous researches suggested a connection between fat foods and PAH concentrations (Ledicia *et al*., 2008).

All the oil samples collected were stored at room temperature which were divided two parts, one were kept in dark place (EG) and the other were treated in normal Condition (CG), respectively. Five samples were selected by using the random choice method to find the change low of the B(*a*)p content tendency treated by different storage conditions, which were showed by Fig. 4. As we can observe that the average levels of B(*a*)p in frying oil which were preserved away from light do not show any major changes with the extension of storage time. However, the B(*a*)p concentrations of frying oil decreased from 18.05 to 17.50 μg/kg with the reduction rate of 3.05% when the samples were kept in room temperature and no light was evaded after 9 months. The results of this study can be accounted for by the reason that B(*a*)p tends to give rise to photolysis under ultraviolet light and when the sample oils were stored at normal condition and no light was avoided, which may bring about the slow decline of the B(*a*)p content.

CONCLUSION

In this study, the concentration of B(*a*)p in frying oil collected in different regions of China were analyzed. Based on the data obtained, levels of B(*a*)P in 86.36% collected samples have exceeded 10 μg/kg regulated by Hygienic standard for edible vegetable oil of China (GB 2716-2005, 2005). B(*a*)P in other oil varieties (consisted of siritch, cottonseed oil, rapeseed oil) showed the highest level among soybean oil, salad oil and blend oil. The oil used for frying animal foods resulted in a higher B(*a*)p level than for vegetable foods, but lower than for compounded food. Meanwhile, the B(*a*)p concentrations of frying oil showed a slow decline when the sample oils were stored at normal condition with a decrease from 18.05 to 17.50 μg/kg with the reduction rate of 3.05%. Considering the high levels of contamination detected in frying oil in the Chinese Market, it is time that relevant programs and regulations should be initiated to avoid the exposure of consumers to excessive amounts of B(*a*)P in their diet.

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