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ALTERATION OF SATURATED AND *TRANS* FAT CONTENTS AND PRICE OF COOKIE PRODUCTS IN TAIWAN MARKET FROM 2015 TO 2018

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Abstract

This study was conducted to assess the levels of saturated and *trans* fat and their relationship with price of imported and domestic cookies in Taiwan market. A sampling of 177, including 95 items of imported and 82 items of domestic, imported and domestic cookie products, were collected at convenient stores, supermarkets and malls in New Taipei City in 2018. The fat content information were obtained from Nutrition Fact panel on product, the price information were recorded from the listing on shelf. A comparison to our previous study in 2015 was conducted. According to Taiwan's regulation, it may be labeled as zero if the *trans* fat content of product was below 0.3 percent. However, 2 of 37 and 0 of 33 cookie products in 2015 and 13 of 95 and 2 of 82 cookie products in 2018 of imported and domestic, respectively are not labeled as zero. Inverse correlation of saturated plus *trans* fat per 100 g of product and price per 100 g of product ($r = -0.23$, $p < 0.05$) was found in domestic cookie products in 2018. Products that are lower in saturated plus *trans* fat may be higher in price of domestic cookie products in 2018. The average prices have difference between imported and domestic cookie products with $t = 3.8$ ($p < 0.01$) in 2018. Even so, the domestic cookie products have less level of saturated fat plus *trans* fat and cheaper than imported products. Consumers need to pay more attentions of *trans* fat and saturated fat content on Nutrition Facts label and price list on the shelf of cookie products in Taiwan market.

Key words: *Trans* fat, Price, cookie

1. Introduction

The *trans* fat is one kind of fat that contain tans-form double bond in configuration structure in unsaturated fatty acid. The *trans* fat in ordinary diet is derived mostly from partially hydrogenated oil, mainly elaidic acid [1]. The shortening oil, oleo, and margarine are the sources of products that contain *trans* fatty acid [2]. Current studies showed that the *trans* fat may cause the high level of low density cholesterol, arterial inflammation and calcification and result in heart disease, and also associated with diabetes [3]-[6]. World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommended that the intake of *trans* fat should keep at below 1% of calories per day [7].

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Many countries in the world have regulated limit or labeling policy to *trans* fat. Canada is the first country that regulate mandatory labeling of *trans* fat on the Nutrition Fact panel in 2005. Denmark is the first country to issue norm to require the *trans* fat content in foods shall not exceed 2% of fat content of product. Austria, Switzerland in 2009, and Iceland, Sweden in 2011 also announce the same regulation as Denmark [8]. The US Food and Drug Administration (FDA) regulated that the *trans* fat may labeled as zero if the intake of *trans* fat per serving of product below 0.5 gram, otherwise, the content level should be labeled in 2006 [9]. The Taiwan Food and Drug Administration (TFDA) issued "Regulations on Nutrition Labeling for Prepackaged Food Products" and regulated that *trans* fat content should be labeled in 2007. The *trans* fat may be labeled as zero if the content of food does not exceed 0.3 percent [10]. TFDA also announced the revised definition of *trans* fat as "all the geometrical isomers of monounsaturated and polyunsaturated fatty acids having non-conjugated carbon-carbon double bonds in the *trans* configuration" on April 15, 2014, and implemented on July 1, 2015 [11]. In addition, TFDA also issued "Ban on the Use of Partially Hydrogenated Oils" on April 22, 2016, and implemented on July 1, 2018 [12]. Partially hydrogenated oil should not be used in all foods in Taiwan

Since the margarine and shortening oil are commonly used in baked snack (biscuit, cookie, cake, pie etc.), fried food (French fries), and popcorn, the *trans* fat contents of cookie products were concerned in this study. The contents of saturated fat and *trans* fat in imported and domestic cookie products marketed in Taiwan were investigated. The *trans* fat content in the margarine has a negative relationship with the price [13]. Whether the *trans* fat contents of imported and domestic cookie products were related to the price was also discussed. The saturated fat has an adverse effect against human cardiovascular disease and diabetes [14]. The saturated plus *trans* fat contents indicated the quality of fat of cookie products in this study. A comparison to our previous study in 2015 was conducted [15].

2. Methods

2.1 Product data

One hundred and seventy seven cookie products, including 95 items of imported and 82 items of domestic samples, were collected from chained convenient stores (SEVEN-ELEVEN, FAMILY) and supermarkets (RT-MART, JASONS MARKET PLACE, WELLCOME) in New Taipei City, Taiwan on August, 2018. The cookie products included biscuit, cracker, wafer, pancake, shortbread, soda cake etc. According to the country of origin on the label of cookie products, the products manufactured in Taiwan were recorded as domestic products, and the others were recorded as imported products. In addition, for each sampled product, information recorded from the label and the Nutrition Facts panel on product included product weight, saturated fat content and *trans* fat content per 100 grams, and the price information were recorded from the label on shelf and shown as NT dollars.

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2.2 Research methods

2.2.1 Quantitative method of data analysis

The items and the range of *trans* fat content of cookie product exceed 0.3 percent of product of the imported and domestic cookie products were shown in Table 1. The distributions were shown to illustrate the conditions of the *trans* fat that exceed 0.3 percent of product. The low and high percentage value of the *trans* fat of cookie product that equal to or exceed 0.3 were shown at range column.

2.2.2 Statistical analysis

All data were collected and entered into SPSS (IBM, versions 22). Pearson correlation was used to get the data of means and standard deviations between the saturated fat plus *trans* fat per 100 grams of the cookie products and the prices per 100 grams of cookie products. Correlation coefficient (r) was used to examine the significance of the relationship. There is a significant correlation when $p<0.05$. Independent-sample t test was used to get the data of the t value of price per 100 grams between imported and domestic cookie products, and the p value was used to examine the significance of the relationship. There is a significant correlation when $p<0.05$.

3. Results

TFDA issued the Regulations on Nutrition Labeling for Prepackaged Food Products in 2007, the *trans* fat content may be labeled as zero if it does not exceed 0.3 percent of the product. Among the 177 cookie products investigated in 2018, the items of *trans* fat content of the product exceed 0.3 percent are 13 out of 95 and 2 out of 82 of imported and domestic products, respectively and the range are 0.3 to 4.0 and 0.3 to 0.4 of imported and domestic products, respectively, as shown in Table 1. In our previous study in 2015 [15], the items of *trans* fat content of the product exceed 0.3 percent are 2 out of 37 and 0 out of 33 of imported and domestic products, respectively and the range are 1.3 and none of imported and domestic products, respectively. The highest value of the percentage of *trans* fat of cookie products both of imported and domestic in 2018 are higher than in 2015. *Trans* fat content of product exceed 0.3 percent of imported cookie product rose from 2 items in 2015 to 13 items in 2018, though the total sample size extended from 37 in 2015 to 95 in 2018. *Trans* fat content of product exceed 0.3 percent of domestic cookie product rose from 0 items in 2015 to 2 items in 2018, though the total sample size extended from 33 in 2015 to 82 in 2018. It seems that the quality of fat content of cookie products did not improved from 2015 to 2018 in Taiwan market

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Table 1. The items and range of *trans* fat above 0.3 percent of cookie products in 2015 and 2018

Year	Imported/Domestic	Items	> 0.3%* (items)	Range (%)
2015				
	Imported	37	2	1.3
	Domestic	33	0	—
2018				
	Imported	95	13	0.3–4.0
	Domestic	82	2	0.3–0.4

* It can be labeled as zero if the *trans* fat content of product is below 0.3 percent.

The independent-sample t test of the price per 100 grams of product between imported and domestic cookie products in 2015 [15] and 2018, shown as Table 2. The price per 100 grams of imported cookie products rose from 36.1 NT dollars in 2015 to 78.0 NT dollars in 2018, meanwhile, the domestic cookie products just rose from 36.8 NT dollars in 2015 to 43.6 NT dollars in 2018. The price of imported and domestic cookie products available in Taiwan market has a significant relationship ($t = 3.80$, $p < 0.01$) in 2018. The results showed that the price of imported and domestic cookie products was significantly different in 2018, but was not in 2015. Since the *trans* fat content has a negative relationship with price, the quality of fat content of cookie products was concerned and worth of studying as followed.

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Table 2. The t-test of price per 100 grams of product between imported and domestic cookie products in 2015 and 2018

Year	Imported/Domestic	Price(NT dollars) / 100 g Product	t	p
		mean ± standard deviation		
2015				
	Imported	36.1±17.1	0.18	0.858
	Domestic	36.8±17.5		
2018				
	Imported	78.0±55.4	3.80	0.00*
	Domestic	43.4±65.1		

*$p < 0.01$

Pearson correlations were used to examine the relationship between the saturated fat plus *trans* fat content of per100 grams and the price per 100 grams of cookie products, as shown in Table3. In 2015 [15], the relationship was non-significant negative of both imported and domestic cookie products. However, a significant negative relationship was revealed of domestic cookie products ($r = -0.23$, $p < 0.05$) in 2018. The significant negative relationship indicated that low in saturated fat plus *trans* fat content tended to be high in price per 100 grams of domestic cookie products in 2018.The saturated fat plus *trans* fat content of per100 grams of imported cookie products were almost unchanged in 2015 and 2018, however, the price per 100 grams of products rose from 36.1 NT dollars in 2015 to 78.0 NT dollars in 2018. The saturated fat plus *trans* fat content of per100 grams of domestic cookie products dropped from 15.1in 2015 to10.8 in 2018, meanwhile, the price per 100 grams of products just rose from 36.8 NT dollars in 2015 to 43.6 NT dollars in 2018. The price of domestic cookie products raised 18.4 percent from 2015 to 2018, meanwhile, the quality of fat content improved 28.5 percent. The price of imported cookie products raised 116.1 percent, however, the quality of fat content just improved 5.7 percent. In view of these results, the quality of fat of imported cookie products did not improved with the raise of price. The effort of removing *trans* fat may cost the cookie manufactures a lot in Taiwan because the legislation of "Ban on the Use of Partially Hydrogenated Oils" implemented on July 1, 2018. It is not surprised to see the reasonable raise of the price of domestic cookie products. May be contributed to the different degree of management and regulation of *trans* fat

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and saturated fat of cookie products in some other countries, the quality of fat content of imported cookie products did not change a lot from 2015 to 2018.

Table 3. The relationship between saturated fat plus *trans* fat and price per 100 g of cookie products in 2015 and 2018

Year	Imported/Domestic	(Saturated fat + *Trans* fat) g/ 100 g product	Price(NT dollars)/ 100 g product	r
		<------mean ± standard deviation ------>		
2015				
	Imported	12.2±6.4	36.1±17.1	–0.24
	Domestic	15.1±12.6	36.8±17.5	–0.01
2018				
	Imported	11.5±6.0	78.0±55.4	0.13
	Domestic	10.8±4.8	43.6±65.1	–0.23*

*$p < 0.05$

4. Discussions

TFDA revised definition of *trans* fat as "all the geometrical isomers of monounsaturated and polyunsaturated fatty acids having non-conjugated carbon-carbon double bonds in the *trans* configuration" and implemented on July 1, 2015. The cookie manufactures in Taiwan may face more stress because the main ingredients of cookie are shortening oil and oleo that usually contain partially hydrogenated plant oils. The decline of *trans* fat in domestic cookie products from 2015 to 2018 showed that the manufactures pay an effort to improve the formulation and reduce partially hydrogenated plant oils that contain the *trans* fat content to meet the requirement of the Act Governing Food Safety and Sanitation in Taiwan. Otherwise, they will be fined of NT$30,000 to NT$3,000,000 by the TFDA of The Ministry of Health and Welfare in Taiwan if the partial hydrogenated oils were still used in food products [16].

Dietary intakes of saturated fats, *trans* fats and sugars are associated with lower dietary costs, and lower chronic disease risk factors are associated with higher dietary prices [17]. Lower contents of *trans* fat of products may have higher prices, and consumers are willing to pay a premium for heathier snacks up to 50 percent [18]. The domestic cookie products had higher

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price in 2018 than in 2015 since the saturated plus *trans* fat content in 2018 was lower than in 2015. The imported cookie products available in Taiwan market did not have the same pattern as domestic ones. Moreover, the price of cookie products in Taiwan market was more expensive in 2018 than in 2015. There was a trick that quality of fat content of domestic cookie products was better than imported cookie products, however, the price was cheaper than imported cookie products. It may contributed to the different management degrees of the *trans* fat of foods in other countries in the world. For example, Japan is the country that has just issued recommendations aimed at reducing consumption of *trans* fat [19], and has no regulation to the use of *trans* fat [20].

In conclusion, the quality of domestic cookie products was generally equal to imported cookie products, however, the price of domestic cookie products was cheaper than the imported cookie products in Taiwan market in 2018. The health-conscious consumers need to pay more attentions to the country of origin and Nutrition Facts on the label and the price list on the shelf of the cookie products in Taiwan market.

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