Quality Analysis of Edible Oils in Markets of Hainan Province

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Abstract: In order to guide the public to purchase healthy and nutritious edible oils, 14 kinds of market edible oils were selected and gas chromatography used to determine the fatty acids. The results showed that, with the exception of tea oil, olive oil 3 and flaxseed oil, the relative content of fatty acids in the other five kinds of oils was greater than 99.50%, with an average value of 99.12%. Most of the fatty acids have been measured. The results showed that the relative content of saturated fatty acids in 14 kinds of edible oils was between 9.45%~21.33%, with an average value of 15.69%; the relative content of unsaturated fatty acids was between 75.69%~88.91%, with an average value of 83.43%, of which the average value of monounsaturated fatty acids was 53.51%, and the average value of polyunsaturated fatty acids was 29.92%. The oil with the highest total content of saturated fatty acids was peanut oil 1, and the lowest was flaxseed oil. The oil with the highest oleic acid content in the unsaturated fatty acids was camellia oil, and that with the highest linoleic acid and linolenic acid content was flaxseed oil, and the oil with highest peanut-tetraenoic acid was tea oil.

1. Introduction

Edible vegetable oils are mainly fats extracted from plant seeds. Fats are important nutrients in food, which can supply human energy and essential fatty acids, and can be used as fat-soluble vitamin carriers, playing an important role in maintaining human health [1]. However, the rapid transformation of society has transformed the dietary pattern of residents into a high-energy, high-fat intake pattern, which leads to the risk of chronic non-communicable diseases [2, 3]. International studies have shown that different diet structure and fatty acid intake ratio are closely related to the occurrence of chronic diseases such as obesity, type 2 diabetes, cardiovascular and cerebrovascular diseases as well as tumors [4-7].

With the improvement of living standards and the deepening understanding of the relationship between lipids and health, residents pay more and more attention to the quality, safety and brand of edible oil and the demand for high-end edible oil has increased significantly [8]. The Chinese Society of Nutrition recommends that the energy supply ratio of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) in the diet be less than 10%, that is, less than 1:1:1[9]. The Food Agriculture Organization/World Health Organization (FAO/WHO) recommends that the intake of trans-fatty acids should not exceed 1% of the total energy [10]. At the same time, nutritionists recommend that the ratio of PUFA to SFA in the diet be higher than 0.45 [11, 12].

The nutritional value of fat and its impact on human health are mainly determined by the composition and content of fatty acids in fat [13, 14]. In order to guide the public to buy healthy and nutritious edible oils, this study selected 14 kinds of market edible oils, used gas chromatography for determination and comparative analysis of fatty acids in the oils, which aims to provide guidance for the public to choose edible vegetable oils reasonably.

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2. Experimental Supplies and Methods

2.1 Experimental Supplies

2.1.1 Experimental Materials

Materials: the 14 edible oils, including tea oil, camellia oil, wild camellia oil, olive oil, peanut oil, flaxseed oil, corn oil, sesame oil were purchased from the markets;

2.1.2 Experimental Instruments

Agilent 7890-fid gas chromatograph; grinding machine, electronic balance; oscillator etc.

2.2 Experimental Method

Methylation of edible oil and Gas chromatography conditions see Wang et al. [15]

3. Experimental Results and Analysis

The saturated fatty acids in the fatty acid components of 14 edible oils determined by this method mainly include palmitic acid, stearic acid, arachidic acid and behenic acid; unsaturated fatty acids include oleic acid, linoleic acid, linolenic acid and arachidonic acid, etc. Except for tea oil, olive oil 3 and flaxseed oil, the relative content of these 8 fatty acid components of the rest oils was greater than 99.50%, with an average value of 99.12%.

As can be seen from Table 1, among the above 8 fatty acids, the relative content of saturated fatty acids in 14 kinds of edible oils was between 9.45%~21.33%, with an average value of 15.69%; the relative content of unsaturated fatty acids was between 75.69%~88.91%, with an average value of 83.43%, of which the average value of monounsaturated fatty acids was 53.51%, and the average value of polyunsaturated fatty acids was 29.92%. Except for tea oil, olive oil 3 and flaxseed oil, the relative content of these 8 fatty acid components of the rest oils was greater than 99.50%, with an average value of 99.12%. Most fatty acids had been measured.

Table 1 Composition and Relative Content of Fatty Acids in 14 Edible Oils

No.	samples	Fatty acid composition/%								
		palmitic acid	stearic acid	oleic acid	linoleic acid	linolenic acid	arachidic acid	arachidonic acid	behenic acid	Sum
1	tea oil	4.99	2.01	57.43	18.60	5.21	0.63	3.27	5.17	97.30
2	cam oil*[1]	9.08	1.94	78.79	8.83	0.20	0.07	0.69	0.07	99.67
3	W cam oil*[2]	4.58	5.51	64.27	16.60	5.87	0.65	1.47	0.62	99.57
4	olive oil 1	11.43	3.83	76.70	6.21	0.60	0.40	0.27	0.23	99.67
5	olive oil 2	13.04	4.93	71.78	8.11	0.79	0.39	0.33	0.21	99.57
6	olive oil 3	6.98	3.63	76.27	6.56	0.57	0.50	0.37	0.17	95.04
7	peanut oil 1	12.10	3.88	42.52	34.81	0.06	1.77	1.04	3.59	99.76
8	peanut oil 2	11.70	3.417	48.308	30.80	0.10	1.46	1.16	2.71	99.65
9	peanut oil 3	14.15	2.77	48.61	31.44	0.24	0.63	0.86	1.10	99.80
10	peanut oil 4	9.27	3.29	52.74	28.95	0.20	1.24	1.38	2.61	99.68
11	peanut oil 5	11.53	4.32	43.85	34.11	0.05 1.77	0.98	3.25	99.86	
12	flaxseed oil	5.96	3.16	20.46	54.95	13.34	0.22	0.16	0.12	98.36
13	corn oil	12.64	1.81	29.79	53.67	0.40	0.53	0.55	0.55	99.94
14	sesame oil	11.65	4.79	37.63	44.46	0.43	0.50	0.24	0.16	99.86

*1 means camellia oil and *2 means wild camellia oil

3.1 Saturated Fatty Acid

Saturated fatty acids are fatty acids without unsaturated bonds in the hydrocarbon chain. It can be seen from Table 1 that the highest saturated fatty acid content of the above four edible oils was peanut oil. The total relative saturated fatty acid content of peanut oil 1 reached 21.33%, and the lower saturated fatty acid content was tea oil, coconut oil, wild camellia oil, camellia oil, Flaxseed oil, of which the lowest content was flaxseed oil, with the relative content 9.45%

The content of each saturated fatty acid in the 14 kinds of edible oil saturated fatty acids was relatively large, and the content of palmitic acid was generally higher, with the relative content 4.58%~14.15%, and the average value was 9.94%. The order was: peanut oil 3> olive oil 2> corn oil> peanut oil 1> peanut oil 2> sesame oil> peanut oil 5> olive oil 1> peanut oil 4> camellia oil> olive oil 3> flaxseed oil > tea oil> wild mountain tea oil; camellia oil had the largest stearic acid content and corn oil had the smallest content. The relative stearic acid content was between 1.81%~5.51%, with an average value of 3.52%. The difference in the content of behenic acid was the largest among all saturated fatty acids, with the relative content between 0.07%~5.17%, and the average value 1.47%, of which the tea oil had the largest content; the average content of arachidic acid among the four saturated fatty acids was the smallest, between 0.07%~1.77%, the average value was 0.77%, peanut oil 5 had the largest content, and camellia oil had the smallest content.

3.2 Unsaturated Fatty Acid

Fatty acids containing one or more unsaturated bonds in the molecule are all unsaturated fatty acids. Among them, monounsaturated fatty acids contain one unsaturated bond and polyunsaturated fatty acids contain more than one unsaturated bond. The average relative content of polyunsaturated fatty acids in 14 edible oils was 83.43%, of which the highest content was in camellia oil, with a relative content of 88.91%.

Table 2 Maximum, Minimum and Average Values of Unsaturated Fatty Acids

	oleic acid	linoleic acid	linolenic acid	arachidonic acid
Maximum/%	camellia oil/78.79	flaxseed oil/54.95	flaxseed oil/13.34	tea oil/3.27
Minimum/%	flaxseed oil/20.46	olive oil /6.21	peanut oil/0.05	flaxseed oil/0.16
Average/%	53.51	27.01	2.01	0.91

3.2.1 Monounsaturated Fatty Acids

Monounsaturated fatty acids are fatty acids that contain an unsaturated bond. The monounsaturated fatty acid in the edible oil was oleic acid. It can be seen from Table 2 that among the above 14 edible oils, the content of oleic acid varied greatly. The largest content was in camellia oil, the relative content was 78.79%, and the smallest content was in flaxseed oil, the relative content was only 20.46%, the average value was 53.51%, the content order was: camellia oil> olive oil 1> olive oil 3> olive oil 2> wild camellia oil> tea oil> peanut oil 4> peanut oil 3> peanut oil 2> peanut oil 5> peanut oil 1> sesame oil> corn oil> flaxseed oil.

3.2.2 Polyunsaturated Fatty Acids

Polyunsaturated fatty acids are fatty acids containing more than one unsaturated bond. The polyunsaturated fatty acids measured in 14 kinds of edible oils were linoleic acid, linolenic acid and arachidonic acid. Linoleic acid and arachidonic acid were ω-6 polyunsaturated fatty acid, linolenic acid was ω-3 polyunsaturated fatty acid. It can be seen from Table 2 that among the 14 edible oils, the content of linoleic acid varied greatly, and the content was generally high overall. The relative content of linoleic acid in flaxseed oil and corn oil was greater than 50%, and the average relative content was 27.01%; the content of linolenic acid in flaxseed oil, wild camellia oil and camellia oil was higher, the content was 13.34%, 5.87% and 5.21% respectively, and the relative content in the rest oils was less than 1%. The content of linolenic acid in peanut oil was relatively low, and the content was only 0.06% and 0.05% respectively, the average relative content was 1.06%; the relative content of arachidonic acid was between 0.16%~3.27%, with the lowest average content

only 0.91% among the three polyunsaturated fatty acids.

4. Discussion

The saturated fatty acids in edible oil mainly include palmitic acid, stearic acid, arachidic acid and behenic acid. Stable in nature and not easy to oxidize, they can provide energy for the human body and can also balance the concentration of free fatty acids in plasma during cardiac function. However, excessive intake may cause obesity, increase blood cholesterol, and even lead to atherosclerosis, increasing the risk of coronary heart disease [16]. Therefore, it is necessary to properly control the human body's intake of saturated fatty acids, especially the amount of saturated fatty acid intake by the elderly must be strictly controlled.

Unsaturated fatty acids are of great benefit to human health. They are essential fatty acids required by the human body. They play an important role in reducing platelet aggregation and reducing the occurrence of thrombosis, and help reduce the risk of cardiovascular disease [17]. Oleic acid can not only provide a large amount of heat energy to the human body, but also adjust the concentration ratio of low and high density lipoprotein cholesterol in human plasma without reducing the concentration of beneficial cholesterol [18]. Therefore, oils with high oleic acid content are considered high-quality oils [19]. The content of oleic acid in camellia oil and olive oil in this study was relatively high and can be supplemented appropriately to prevent and improve cardiovascular and cerebrovascular diseases. Polyunsaturated fatty acids are essential fatty acids for the human body. The human body cannot synthesize them and must be supplemented from the daily diet, especially edible oils, especially vegetable oils [20]. However, studies have shown that excessive intake of ω-6 polyunsaturated fatty acids can affect immune cell function and reduce the body's immunity [21]. ω-3 polyunsaturated fatty acids can eliminate the excessive intake of ω-6 polyunsaturated fatty acids, and can also improve diseases such as allergic dermatitis, hay fever, and tracheal asthma[22]. The World Health Organization recommends that the golden ratio of linolenic acid to linoleic acid in edible oil is 1:4, and the ideal ratio of saturated fatty acid, monounsaturated fatty acid and polyunsaturated fatty acid ratio is 1:6:1. The diversification of edible oil can ensure the balance of nutrients in the living body [17]. The ratios of linolenic acid and linoleic acid in the tea oil and wild camellia oil in this study were 1:4, 1:4 and 1:3, respectively. They are recommended for the elderly, pregnant women and children.

Flaxseed oil is one of the vegetable oils with the highest linolenic acid content, with a relative content of 53.36%~65.84% [23]. The relative content of linolenic acid in the flaxseed oil sampled in this study was only 13.34%, and the flaxseed oil we bought might be counterfeit products.

5. Conclusion

In this study, the fatty acids of 14 kinds of edible oils were measured and analyzed. Except for tea oil, olive oil 3 and flaxseed oil, the relative content of the rest was greater than 99.50%, with an average of 99.12%. Most of the fatty acids have been measured. The results showed that the relative content of saturated fatty acids in 14 kinds of edible oils was between 9.45%~21.33%, with an average value of 15.69%; the relative content of unsaturated fatty acids was between 75.69%~88.91%, with an average value of 83.43%, of which the average value of monounsaturated fatty acids was 53.51%, and the average value of polyunsaturated fatty acids was 29.92%. The oil with the highest total content of saturated fatty acids was peanut oil 1, and the lowest was flaxseed oil. The oil with the highest oleic acid content in the unsaturated fatty acids was camellia oil, and that with the highest linoleic acid content was flaxseed oil, and the oil with highest linolenic acid and peanut-tetraenoic acid was tea oil. The ratios of linolenic acid and linoleic acid in the tea oil and wild camellia oil in this study were 1: 4 and 1: 3, respectively, which meets the healthy edible oil standards recommended by WHO. We believe that the market demand of the tea oil and wild camellia oil will increase.

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