A Comparative Analysis of Inhibitory Effect of Different Levels of Ya'an Tibetan Tea on Lipase

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Abstract. In this experiment, the inhibition effects in vitro and inhibition type of different levels of Ya'an Tibetan tea on lipase were studied by measuring its biochemical components, enzyme activity, and semi-inhibitory concentration. The results showed that the higher the grade of Ya'an Tibetan tea, the higher the content of water extracts, tea polyphenols, caffeine, free amino acids, soluble sugars and theabrownins. At the same tea soup concentration, the inhibition rate of all of Ya’an Tibetan tea on lipase showed an increasing trend with the increase of tea soup concentration. The IC50 of the semi-inhibitory concentration of inhibitory effect of each tea sample on lipase was greater than 20 mg. mL⁻¹. The order of the inhibitory ability on lipase were Jixiang level one and Jixiang level three>Jixiang level two, Yixing level one and Yixing level three>Yixing level two. The inhibition types were all mixed type of reversible inhibition between competitive and non-competitive inhibition, which was closer to competitive inhibition. The inhibition was a mixed type of reversible competitive and non-competitive inhibition, which was close to the competitive inhibition. The results showed that different levels of Ya'an Tibetan tea had good inhibitory effects on lipase, and could be developed and used as natural lipase inhibitors.

1. Introduction

Obesity is a nutritional metabolic disorder caused by genetic and environmental factors. It can induce various chronic diseases and increase the morbidity and mortality of diabetes, hypertension, ovarian cancer and colon cancer. With the acceleration of life rhythm and the change of dietary structure, the incidence and mortality of obesity are increasing year by year. Obesity has become a worldwide disease [1, 2]. Lipase is a key enzyme and rate-limiting enzyme for the absorption and utilization of lipids in the digestive system [3]. Triglycerides in food are hydrolyzed into monoglycerides and free fatty acids under the action of lipase, which are absorbed by intestinal tract to synthesize fat. Excessive fat accumulation will lead to obesity [4, 5]. It has been found that inhibition of lipase activity can reduce the absorption of lipid decomposition products, hinder the accumulation and synthesis of fat in the body, and reduce the incidence of obesity [6, 7]. Lipase inhibitors have become a research hotspot at present. At present, the lipase inhibitors include Semicolon, and the active ingredient is orlistat. They are the only lipase inhibitors used clinically for weight loss, but they still have some...
gastrointestinal toxicity and side effects [8]. Therefore, it is of great significance to find natural, efficient and non-toxic lipase inhibitors to reduce the morbidity and mortality of obesity.

Dark tea is a unique kind of tea in China and one of the six basic types of tea. Ya'an Tibetan tea is the earliest dark tea in history and the most typical dark teas which can be divided into Kangzhuan, Jinjian and Fangbao. Ya'an Tibetan tea which is made by special fermentation technology contains abundant beneficial compounds for human body. In addition, the Tibetan tea soup is rich in red, bright, mellow and sweet, tasty, pure and smooth, and aged fragrant is remarkable. Therefore, Ya'an Tibetan tea is deeply loved by Tibetans and has become a good prescription for minority nationalities in frontier areas such as Qinghai-Tibet for thousands of years to prevent diseases. With the discovery of health care efficacy, especially its good effect of reducing fat and weight [9], Ya'an Tibetan tea has been accepted by inland consumers, and has become a health tea for urban people to lose weight and reduce the "three highs" people.

The health effects of Ya'an Tibetan tea vary with different raw materials and grades. Therefore, this experiment intends to explore the effect of Ya'an Tibetan tea on lipase inhibition in vitro through the study of different levels of Ya'an Tibetan tea, to provide new ideas for finding natural fat-reducing and weight-reducing materials, and has great practical significance for the development of Ya'an Tibetan tea products and the promotion of the revitalization of Sichuan border tea industry.

2. Materials and Methods

2.1. Experimental materials

In this experiment, Ya'an Tibetan tea produced by different manufacturers in the main production area of Ya'an Tibetan tea was used as the test material as shown in Table 1.

| Numbering | Tea sample | Grade                  | Raw tea manufacturer                       | Levels                                      |
|-----------|------------|------------------------|--------------------------------------------|--------------------------------------------|
| 1         | Black gold brick | Yixing Level 1 | Yixing Tibetan tea Co., Ltd. | One bud, three four leaves, with stem |
| 2         | Black gold brick | Yixing Level 2 | Yixing Tibetan tea Co., Ltd. | One bud four five leaves, with stem |
| 3         | Black gold brick | Yixing Level 3 | Yixing Tibetan tea Co., Ltd. | One bud five six leaves, multiple stalks |
| 4         | Hand built brick | Auspicious level 1 | Auspicious Tea Industry Co., Ltd. | One bud, three four leaves, with stem |
| 5         | Tibetan tea brick | Auspicious level 2 | Auspicious Tea Industry Co., Ltd. | One bud four five leaves, with stem |
| 6         | Lucky brick | Auspicious level 3 | Auspicious Tea Industry Co., Ltd. | One bud five six leaves, multiple stalks |

Lipase (Sigma, USA), ethanol, petroleum ether, ethyl acetate, diethyl ether, n-butanol, Tris (tris), hydrochloric acid, p-NPB (p-nitrophenylbutyrate), p-nitrophenol, DMSO (dimethyl sulfoxide), etc., were of analytical grade. SHY-2A water bath thermostatic oscillator (Changzhou Guoyu Instrument Manufacturing Co., Ltd.), HH-6 digital constant temperature water bath (Changzhou Aohua Instrument Co., Ltd.), SHZ-D circulating vacuum pump (Gongyi Yuhua Instrument Co., Ltd.), RE-2000 Rotary Evaporator (Shanghai Yarong Biochemical Instrument Factory), High Speed Refrigerated Centrifuge (Sigma, USA), SPX-250 Biochemical Incubator (Shanghai Shenxian Thermostatic Equipment Factory), UV-2300 UV-Vis Spectrophotometer (Japan Hitachi).
2.2. Experimental methods

2.2.1. Solution preparation. Preparation of Tibetan tea extracts [10]: 5.00g of various grades of Ya'an Tibetan tea were weighed and ground. The ground tea samples in 100mL Erlenmeyer flask was added to 40mL boiling distilled water and diluted in 100°C constant temperature water bath for 25 min, After the same method 3 times, the filtrate was combined and centrifuged at 4000 r/min for 20 min. The supernatant was concentrated by rotary evaporation to a concentration of 160 mg•mL⁻¹. 5 mL of each tea sample concentrate was dried at 100°C, and the dry matter weight was weighed, and the milligrams of dry matter in each tea sample per ml of the concentrated liquid was obtained as the mass concentration of the tea leaves.

Preparation of lipase solution [11, 12]: 0.5g of enzyme powder into the mortar was weighed and grind with a small amount of pH 8.0 Tris-HCl buffer to into a paste, and then made up to 100mL with buffer to a concentration of 5mg. mL⁻¹ and then centrifuged at 1200 r/min for 1 min at 4°C. The supernatant was stored in a refrigerator at -20°C for use.

Preparation of substrate solution: 0.2542g of p-NPB was weighed, and dissolved it in DMSO, and diluted to a 25mL volumetric flask, the concentration is 0.01moL•L⁻¹, and was put it in the refrigerator at -2°C for using.

Preparation of Tris-HCl (pH=8.0) buffer preparation: 6.0575g Tris was accurately weighed, and dissolved in water to 250mL, which is 0.2mL. L⁻¹ Tris solution. 25 mL of Tris solution was pipetted into a volumetric flask containing 25 mL of 0.1 mol L. L⁻¹ HCl, and dilute to 100 mL of distilled water to obtain a 0.05 mol/L⁻¹ Tris-HCl buffer at pH=8.0.

Preparation of p-nitrophenol: 0.1391 g of p-nitrophenol was weighed, and dissolved in DMSO, and diluted to a 25 mL volumetric flask at a concentration of 10 μmol L.mL⁻¹.

2.2.2. Determination of main biochemical components in Ya'an Tibetan tea. Moisture content: according to GB/T 8304-2013 [13]; caffeine: ultraviolet spectrophotometry [14]; amino acid: ninhydrin colorimetric method [15]; total amount of catechin: vanillin colorimetric method; tea Polyphenols: ferrous tartrate colorimetric method; soluble sugar: anthrone-sulfuric acid method; tea polysaccharide: anthrone-sulfuric acid method [16]; tea pigment determination: system colorimetry [17]; water extract: full amount method [18].

2.2.3. Determination of lipase activity [19-21]

1) Drawing of the standard curve of p-nitro phenol. 6 reaction tubes were taken and 1.0, 2.0, 3.0, 4.0, 5.0mL of 10μmol L•mL⁻¹ p-nitro phenol were added, and then made up to 5mL with DMSO, the concentration of p-nitro phenol was 2.0, 4.0, 6.0, 8.0, respectively. A solution without p-nitro phenol was used as a blank control, colorimetric at 405 nm, absorbance as ordinate, and concentration of p-nitro phenol as abscissa, plotting p-nitro phenol standard curve line.

2) Lipase activity assay. 2.1 mL 0.05 moL·L⁻¹ Tris-HCl buffer (pH=8.0) and 300 μL enzyme solution were preheated in an incubator for 30 min, and then 100 μL 0.01 mol·L⁻¹ ρ-NPB substrate solution was added to the water bath at 37°C. After shaked for 15 min on a constant temperature shaker, 5 mL of absolute ethanol was immediately added to terminate the reaction. The blank solution without lipase was used as a blank control. The absorbance value was measured at a wavelength of 405 nm, and the concentration of p-nitro phenol was determined on a p-nitro phenol standard curve.

3) Lipase activity calculation. The unit of lipase enzyme activity is defined as the amount of enzyme that releases 1 μmol of p-nitro phenol per minute under certain conditions as one unit of lipase activity (U). The enzyme activity was calculated as follows.

\[
X = \frac{cv}{v't}
\]

“X” was the lipase activity (U·mL⁻¹), “c” is the p-nitro phenol concentration (μmoL·mL⁻¹), “V”
was the total volume of the reaction liquid (mL), “V” was the amount of the enzyme solution (mL), and “t” was the reaction time (min).

2.2.4. Lipase semi-inhibitory concentration determination. According to the method of 2.2.3.2, 2.1 mL of buffer solution and 300 μL of Tibetan tea solution with concentration of 0, 2.5, 5, 10, 20, 40, 80, 160 mg·mL\(^{-1}\) were preheated with 300 μL of enzyme solution for 30 min. The residual activity of lipase was calculated. The inhibition rate of lipase at different concentrations of Tibetan tea extract was calculated. The repetition rate was set to 3 times. According to the tea concentration, the IC\(_{50}\) was calculated by SPSS software. The inhibition rate was calculated as follows:

\[
\text{Inhibition rate} = \frac{\text{Enzyme activity before inhibition} - \text{Enzyme activity after inhibition}}{\text{Enzyme activity before inhibition}} \times 100\% \quad (2)
\]

2.2.5. Lipase inhibition type determination. According to the method of 1.3.3.2, 2.1 mL buffer solution and 300 μL concentration of 0, 10mg·mL\(^{-1}\) Tibetan tea solution and 300 μL concentration of 2, 3, 4, 5 mg·mL\(^{-1}\) enzyme solution were preheated for 30 min. The lipase activity was determined according to the Dixon mapping method, the enzyme concentration was plotted on the abscissa, and the lipase activity was plotted on the ordinate.

According to the method of 1.3.3.2, 2.1 mL buffer solution and 300 μL concentration of 0, 10, 20 mg·mL\(^{-1}\) Tibetan tea solution and 300 μL 5mg·mL\(^{-1}\) enzyme solution were preheated for 30 min, and then adding to the concentration of 100 μL 1, 2, 3, 4mmol L\(^{-1}\) ρ-NPB substrate solution, the lipase activity was determined and 3 repetitions was set up. According to the double reciprocal mapping method of Line weaver-Burk, with the inverse of the mass concentration of the substrate solution as the abscissa and the enzyme activity as the ordinate, a double reciprocal curve was drawn to determine the inhibition type [22, 23].

2.3. Data processing
Data processing was performed by using SPSS 22.0. All data were expressed as mean ± standard deviation. The results were significantly different at P < 0.05, and the difference was extremely significant at P < 0.01.

3. Results and discussion

3.1. Determination of the content of main components in different grades of Ya’an Tibetan tea
The determination results of the main components of each tea sample were shown in Table 2. It can be seen from Table 2 that the contents of water extract, tea polyphenols, caffeine, free amino acids, tea polysaccharides, soluble sugar and theabrownins in Xixiang Level 1 were significantly higher than that of Xixiang Level 2 which was significantly higher than that of Xixiang Level 3. The difference of catechins and theabrownins content among three levels was not significant.

The content of thearubins in Xixiang Level 1 was significantly lower than that of Xixiang Level 2 and Xixiang Level 3, and the difference between Xixiang Level 2 and Xixiang Level 3 was not significant. The content of water extract, tea polyphenols, caffeine, free amino acids, soluble sugar, catechins and theabrownins in Jixiang Level 1 was significantly higher than that of Jixiang Level 2, and Jixiang Level 2 was significantly higher than Jixiang Level 3. The content of tea polysaccharide in Jixiang Level 2 was significantly higher than that of Jixiang Level 1, and the Jixiang Level 1 was significantly higher than the Jixiang Level 3, the content of thearubins in Jixiang Level 1 was significantly higher than that of Jixiang Level 2 and Jixiang Level 3, and the difference of the content of thearubins between Jixiang Level 2 and Jixiang Level 3 was not significant, and the difference of theaflavins content among three levels was not significant. As can be seen from the above, the higher the grade, the higher the content of water extract, tea polyphenols, caffeine, free amino acids, soluble sugars, and
theabrownins. This was consistent with the research results of Chen et al. The content of tea polysaccharide in tea was closely related to the tea grade. With the decline of the grade, the coarser the tea leaf, the higher the content of tea polysaccharide, but the less the content of caffeine, tea polyphenols and catechins [24-26].

Table 2. Content of the main of Y’aan Tibetan tea (±s, %)

|                   | Yixing Level 1 | Yixing Level 2 | Yixing Level 3 | Jixiang Level 1 | Jixiang Level 2 | Jixiang Level 3 |
|-------------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|
| Water             | 11.92±0.20bB   | 12.27±0.06aA   | 12.43±0.09aA   | 11.61±0.01cC    | 11.07±0.00dD    | 12.23±0.05aA    |
| Water extract     | 32.51±1.50bB   | 28.26±0.16cC   | 23.75±0.97dD   | 36.13±0.43aA    | 29.84±1.90bB    | 20.80±0.43cE    |
| Tea polyphenols   | 8.615±0.05bB   | 6.355±0.26cC   | 4.730±0.16dD   | 9.400±0.16aA    | 5.980±0.16cC    | 3.230±0.06E     |
| Caffeine,         | 3.885±0.01aA   | 2.895±0.02cC   | 2.225±0.01aE   | 3.130±0.01bB    | 2.330±0.01dD    | 2.155±0.04F     |
| Free amino acids  | 0.9550±0.01bA  | 0.7550±0.05dC  | 0.6650±0.02dD  | 1.0450±0.02cA   | 0.7550±0.08bB   | 0.6650±0.01cA   |
| Tea polysaccharides | 3.345±0.18aA   | 2.525±0.02bb   | 1.775±0.06dD   | 2.190±0.01cC    | 2.585±0.08bb    | 1.615±0.15dD    |
| Soluble sugar     | 5.075±0.09aA   | 4.595±0.21bc   | 3.750±0.14dC   | 5.285±0.02aA    | 4.750±0.04bBC   | 3.665±0.16dD    |
| Catechin          | 0.7800±0.14cC  | 0.7650±0.06cc  | 0.7150±0.13eC  | 2.190±0.01aA    | 1.010±0.04dBC   | 0.6100±0.04cC   |
| Theaflavin        | 0.1000±0.01aA  | 0.0700±0.01aA  | 0.0700±0.00aC  | 0.0450±0.01cA   | 0.0850±0.05aA   | 0.0350±0.01aA   |
| Thearubins        | 0.1750±0.01bB  | 0.3150±0.06dC  | 0.520±0.10ab   | 0.6650±0.02dA   | 0.3450±0.02bB   | 0.2500±0.03aB   |
| Theabrownins      | 5.520±0.10aA   | 4.500±0.06bB   | 3.465±0.06cC   | 3.180±0.11dd    | 2.535±0.08eE    | 1.970±0.08bF    |

Note: The lowercase English letters indicated the significant differences in the 0.05 level, and the uppercase English letters indicated the extremely significant differences in the 0.01 level. The below was the same.

3.2. The inhibitory effect of different grades of Ya’an Tibetan tea on lipase

3.2.1. Effect of Ya’an Tibetan tea at Different Levels on Lipase Inhibition Rate. The results of measuring the inhibition rate of each tea sample on lipase were shown in fig. 1. It can be seen from fig 1 that when the concentration of tea soup was 20mg·mL⁻¹, the inhibition rate of Yixing Level 1 was significantly higher than that of Yixing Level 2 and Yixing Level 3, and the difference between Yixing Level 2 and Yixing Level 3 was not significant. The Jixiang level 1 was significantly higher than the Jixiang level 2 and the Jixiang level 3. The difference between the Jixiang level 2 and the Jixiang level 3 was not significant. The inhibition rate of each tea sample on lipase was Yixing Level 1 > Yixing Level 2 > Yixing Level 3, Jixiang Level 1 > Jixiang Level 2 > Jixiang Level 3, and the greater the inhibition rate, the better the inhibition effect, and the higher the grade of tea the inhibitory effect the better. When the concentration of tea soup was 40mg·mL⁻¹ the Yixing level 1 was significantly higher than that of Yixing Level 2 and Yixing Level 3. The difference between Yixing Level 2 and Yixing level 3 was not significant. TheJixiang level 1 was significantly higher than the Jixiang level 2, Jixiang level 2 was significantly higher than the Jixiang level 3, the inhibition rate of each tea sample on the lipase was Yixing level 1 > Yixing level 3 > Yixing level 2, Jixiang level 1 > Jixiang level 2, Jixiang level 3 > Jixiang level 2. When the concentration of tea soup was 80mg·mL⁻¹, the difference between Yixing Level 1, Yixing Level 2 and Yixing Level 3 was not significant. The Jixiang level 1 was significantly higher than the
Jixiang Level 2 and Jixiang Level 3, and the Jixiang Level 2 and Jixiang Level 3 difference not significant, the inhibition rate of each tea sample on lipase was in the order of Yixing Level 1 > Yixing Level 3 > Yixing Level 2, Jixiang Level 1 > Jixiang Level 2 > Jixiang Level 3. When the concentration of tea soup was 160mg·mL$^{-1}$, the difference between Yixing Level 1 and Yixing Level 3 was not significant, which was significantly higher than Yixing Level 2. The difference between Jixiang Level 2 and Jixiang Level 3 was not significant and they were significantly lower than the Jixiang Level 1. The inhibition rate of tea samples on lipase was in the order of Yixing Level 3 > Yixing Level 1 > Yixing Level 2, Jixiang Level 1 > Jixiang Level 2 > Jixiang Level 3. At the same concentration, the effect of different levels on lipase was different. The inhibition rate of lipase by Jixiang Level 1, Yixing Level 1 and Yixing Level 3 reached 50%, and the other tea samples did not reach 50% inhibition rate. The inhibition rate of lipase on tea samples showed an increasing trend with the increase of tea concentration.

![Figure 1. Inhibitory effect of Ya'an Tibetan tea on lipase](image)

3.2.2. Effect of Ya'an Tibetan tea at Different Levels on Semi-inhibitory Concentration of Lipase. The results of measuring the mass concentration of each tea leaf were shown in Table 3. It can be seen from Table 3 that the first-class mass concentration of Yixing Level 1 was significantly higher than that of Yixing Level 2, and the Yixing Level 2 was significantly higher than that of Yixing Level 3. The Jixiang Level 1 was significantly higher than the Jixiang Level 2, and the Jixiang Level 2 was significantly higher than the Jixiang Level 3. The mass concentration was Yixing Level 1 > Yixing Level 2 > Yixing Level 3, Jixiang Level 1 > Jixiang Level 2 > Jixiang Level 3. The higher the tea grade, the higher the mass concentration and the more dry matter content.

The semi-inhibitory concentration of each tea sample on lipase was calculated according to the mass concentration of each tea leaf using SPSS 22.0. The results were shown in Table 4. It can be seen from Table 4 that the semi-inhibitory concentration of lipase in Yixing Level 2 was significantly higher than that of Yixing Level 1 and Yixing Level 3. The difference between the Jixiang Level 2 and Jixiang Level 3 and semi-inhibitory concentrations was not significant, and the Jixiang Level 1 was significantly lower than the Jixiang Level 2 and Jixiang Level 3. The semi-inhibitory concentration of each tea sample on lipase was as follows: Yixing Level 2 > Yixing Level 1 > Yixing Level 3, Jixiang Level 2 > Jixiang Level 1 > Jixiang Level 3.
Level 2 > Jixiang Level 3 > Jixiang Level 1, the smaller the semi-inhibitory concentration, the stronger the inhibition ability. The inhibition ability of tea samples on lipase was followed by Yixing Level 3 > Yixing Level 1 > Yixing Level 2, Jixiang Level 1 > Jixiang Level 3 > Jixiang Level 2.

Table 3. Various concentrations of Ya'an Tibetan tea (±s, mg·mL⁻¹)

| Tea mass concentration | Yixing Level 1 | Yixing Level 2 | Yixing Level 3 | Jixiang Level 1 | Jixiang Level 2 | Jixiang Level 3 |
|------------------------|---------------|---------------|---------------|----------------|----------------|----------------|
|                        | 50.12±0.28^aA| 35.81±0.42^cC| 30.29±0.14^dD| 42.90±0.20^bB| 35.82±0.25^cC| 26.09±0.99^eE |

Table 4. Inhibitory concentrations of Ya'an Tibetan tea on lipase (±s, mg·mL⁻¹)

| IC₅₀ | Yixing Level 1 | Yixing Level 2 | Yixing Level 3 | Jixiang Level 1 | Jixiang Level 2 | Jixiang Level 3 |
|------|----------------|---------------|---------------|----------------|----------------|----------------|
|      | 24.32±0.36^aB | 34.04±9.01#bB| 23.55±0.99^bB| 22.50±2.15#bB| 37.83±0.28^aA| 36.65±0.59#bB |

3.3. Types of inhibition of lipase by different levels of Tibetan tea

3.3.1. Reversible or irreversible suppression type judgment. According to the manner and characteristics of the combination of the inhibitor and the enzyme, the type of inhibition can be divided into two types: reversible inhibition and irreversible inhibition. It can be seen from figure 2 that each tea sample rate passes through the origin within the error tolerance range, and it was concluded that the inhibition type of lipase by each tea sample as an inhibitor was reversible inhibition.
3.3.2. Reversible suppression of competition type judgment. Reversible inhibition was divided into three types: competitive, non-competitive, and anti-competitive inhibition [27]. It can be seen from Fig. 3 that the straight lines in the double reciprocal graphs of each tea sample were in the second quadrant, which were typical mixed inhibition between competitive and non-competitive, which was closer to competitive inhibition.

Figure 2. Inhibition type of Ya'an Tibetan tea on lipase
Figure 3. Line weaver-Burk plot of reversible inhibition of Ya'an Tibetan tea on lipase
4. Conclusion
Ya'an Tibetan tea had an inhibitory effect on lipase, which was the result of the combined action of various tea catechins, theaflavins, theabrownins and thearubigins [3]. Saponins and terpenes had a certain inhibitory effect on lipase and were dose-dependent [8, 28]. The results of the experiment showed that the higher the tea grade, the higher the content of water extract, tea polyphenols, caffeine, free amino acids, soluble sugar and theabrownins pigment. At the same concentration, different levels of lipase had different effects. The inhibition rate of lipase on each tea sample increases with the increase of tea concentration. The higher the inhibition rate, the better the inhibition effect. The higher the tea grade, the more the dry matter content. The half-inhibitory concentration IC50 of each tea sample to lipase was greater than 20 mg·mL-1, and the inhibition ability for lipase was Yixing Level 3 > Yixing Level 1 > Yixing Level 2, and Jixiang Level 1 > Jixiang Level 3 > Jixiang Level 2, the results may be inconsistent with the same concentration, the dry matter content of each grade of Ya'an Tibetan tea extract per ml was different, and within a certain concentration range, one or more substances in different grades of Ya'an Tibetan tea The inhibition of lipase was related to a dose-dependent relationship. Therefore, the inhibitory effect of different grades of Ya'an Tibetan tea on lipase needs further study.

In summary, the first- and third-grade of Ya'an Tibetan tea provided by the two manufacturers had better inhibitory effects on lipase than the second-grade Ya'an Tibetan tea. All grades of Ya'an Tibetan tea had inhibitory effects on lipase. The inhibition mechanism was a mixed and reversible inhibition between competitive and non-competitive inhibition and it was closer to competitive inhibition.

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