Preparation and Nutritional Characterization of Perilla Chewable Tablet

Jinhong Wu\textsuperscript{a}, Chunmei Yang\textsuperscript{a}, Yuzhi Rong\textsuperscript{a}, Zhengwu Wang\textsuperscript{a} \textsuperscript{*}

\textsuperscript{a}Department of Food Science and Technology, Bor S. Luh Food Safety Research Center, School of Agriculture and Biology, Shanghai Jiao Tong University, 800 Dongchuan Road, Minhang District, Shanghai 200240, China

**Abstract**

In this study, the preparation and trophic characterization of perilla chewable tablet were investigated. Perilla chewable tablet was prepared according to the following process: mixing perilla raw materials with excipients, making wet granules, drying, tabletting and coating. The optimal formula was determined as follows: 8% perilla powder, 2.5% perilla extract powder, 20% isomaltooligosaccharide, 20% microcrystalline cellulose, 44.4% lactose, 0.5% essence of perilla, 0.1% sucralose, 2% erythritol, 2% vitamin C, 0.5% magnesium stearate. Results from nutrient analysis showed that perilla chewable tablet was rich in essential vitamins and mineral substances, which are good for human health.

© 2012 Published by Elsevier Ltd. Selection Open access under CC BY-NC-ND license.

**Keywords:** Perilla; Chewable tablet; Preparation; Nutritional characterization; Formula

1. Introduction

Perilla (Perilla frutescens) is a purplish herbaceous plant native to Asia, and its leaves are often used in Asian gourmet food or for medicinal purposes. Researches showed that perilla is rich in protein, vitamins and minerals, and rosmarinic acid, polyphenols, flavonoids, perilla aldehyde, \(\alpha\)-linolenic acid and other

\* Corresponding author. Tel.:+86-021-34205748; fax: +86-021-34205748.

\textit{E-mail address: zhengwuwang@sjtu.edu.cn}
biologically active substances [1]. Recently, considerable attentions have been given to the health benefits of perilla, such as anti-allergic [2], anti-oxidation, anti-cancer [3], anti-tumor [4], antibacterial [5], and anti-HIV [6]. Because of the attractive color and flavor, high in edibleness and medicinal value, perilla is widely used as an important functional food material in the food industry.

Chewable tablet is a kind of new solid food product forms, which is easy to take, has a good taste and nice chewing property, and befits to keeping the stability of active ingredients of product and increasing bioavailability. Recently, researches show that chewable tablet is useful in the preparation of leisure and health food, such as oats dietary fiber chewable tablets[7], amino acid chelated calcium milk flavored chewable tablets [8], natto chewable tablets [9].

There are no perilla chewable tablets in the market so far. Therefore, the present study was designed to develop the preparation technique of perilla chewable tablet and further analyze the nutrition composition of the obtained product.

2. Methods

2.1. Preparation process of perilla chewable tablet

Perilla chewable tablet was made from perilla leaf under the process flowchart as shown in Fig.1.

Fig.1. The process flowchart for preparation of purple perilla chewable tablet

To take advantage of the flavor and purple color of perilla extract powder, the perilla raw materials consists of perilla leaf powder and perilla extract powder. The granules were prepared by wet granulation. The process for preparation of perilla chewable tablet product involved weighing excipients according to a design formula, screening through a sieve No. 100-mesh and mixing with perilla raw materials, preparing a damp mass, screening the damp mass into granules by passing through a sieve no.18-mesh, drying of granules by fluidized bed at 50 °C for 4 h, sieving granules by passing through sieve no.20-mesh, adding lubricants (magnesium stearate) and a disk-shaped tablet (2 cm diameter) formation by rotary press tablet compression machine, and coating using the coating material (product code, 290F600002 ) provided by Colorcon Company.
2.2. Optimum formula of perilla chewable tablet

According to some preliminary experiments (data not shown), the suitable formula compositions of perilla chewable tablet were the perilla raw material (perilla powder coupled with perilla extract powder), isomaltooligosaccharide, microcrystalline cellulose (MCC), vitamin C, erythritol, essence of perilla, lactose and magnesium stearate. Thereinto, vitamin C was used as acidity regulator, sucralose and erythritol were used as sweetening agents, perilla essence was used to improve the flavor of the chewable tablets, lactose was used as a diluent and filler, and magnesium stearate was used as lubricants.

It was found that the main affecting factors of the organoleptic properties of chewable tablets were perilla powder (PP), perilla extract powder (PEP), and adhesive mixtures (consisting of isomaltooligosaccharide and MCC at a mass ratio of 1:1). In order to optimize the formula compositions, the orthogonal experiment (L₉(3⁴)), including three-factors and three-levels (as shown in Table 1) was used to get the best formula of perilla chewable tablet.

Table 1. Factors and levels of the orthogonal experiment

| Level | Factors | Level A | Level B | Level C |
|-------|---------|---------|---------|---------|
| 1     | PP (%)  | 5       | 20      | 2.5     |
| 2     | Adhesive mixtures (%) | 8       | 30      | 3.0     |
| 3     | PEP (%) | 10      | 40      | 3.5     |

Notes: the adding dosage of other excipients were as follows: 2 % of vitamin C, 2 % of erythritol, 0.5 % of essence of perilla, 44.4 % of lactose, 0.5 % of magnesium stearate.

The organoleptic properties, including perilla flavor, taste of sour and sweet, mouthfeel, appearance, hardness were scored according to the sensory evaluation standards presented in Table 2, and the total score was used as an indicator for analysis of the orthogonal experiment test.

Table 2. Sensory evaluation standards for perilla chewable tablets

| organoleptic property | Score |
|-----------------------|-------|
|                       | 5     | 3     | 1     |
| perilla flavor        | strong flavor | middle flavor | week flavor |
| sour and sweet        | moderate taste | a little sour or sweet | much too sour or sweet |
| mouthfeel             | delicate mouthfeel | A little rough | very rough |
| appearance            | bright purple, smooth, no cracking | light purple, a little rough and a little cracking | White, very rough and obvious cracking |
| hardness              | easy to chew | a little hard to chew | very hard to chew |
| Total score           | 25    | 15    | 5     |
2.3. Determination of nutrients of perilla chewable tablets

The nutrients of perilla chewable tablets, including moisture, protein, fat, coarse fiber, $V_C$, $V_D$, $V_{B2}$, $\beta$-carotene, $V_{K1}$ were determined respectively according to the chinese national standard methods (GB5009.3-2010, GB5009.5-2010, GB/T5009.6-2003, GB/T5009.10-2003, GB5413.18-2010, GB5413.9-2010, GB5413.12-2010, GB/T5009.83-2003, GB5413.10-2010). In addition, the content of carbohydrate and calorie of perilla chewable tablet were analyzed according to chines food nutrition labels standard. The six microelements including Ca, Fe, Zn, Mg, Mn, and Cu in perilla chewable tablet were determined using Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES, USA)[10].

3. Results and discussion

All the tablets were prepared according to the process flowchart as shown in Fig.1. The orthogonal experiment for optimization of the formula of perilla chewable tablet was carried out and the results and statistical analysis were shown in Table 3.

Table 3 Statistical analysis of the results from orthogonal experiment

| Trial number | A  | B  | C  | Score |
|--------------|----|----|----|------|
| 1            | 1  | 1  | 1  | 13   |
| 2            | 1  | 2  | 2  | 13   |
| 3            | 1  | 3  | 3  | 18   |
| 4            | 2  | 1  | 2  | 18   |
| 5            | 2  | 2  | 3  | 17   |
| 6            | 2  | 3  | 1  | 23   |
| 7            | 3  | 1  | 3  | 14   |
| 8            | 3  | 2  | 1  | 20   |
| 9            | 3  | 3  | 2  | 17   |
| K1           | 14.667 | 15.000 | 18.667 |
| K2           | 19.333 | 16.667 | 16.000 |
| K3           | 17.000 | 19.333 | 16.333 |
| R            | 4.666 | 4.333 | 2.667 |

The K and R values in Table 3 were calculated following the procedures described by Ling et al. [11]. The R value showed that adding amount of perilla powder had the most significant effect on the organoleptic properties of perilla chewable, and the order of importance that influenced the organoleptic properties of perilla chewable tablet was found to be as follows: adding amount of perilla powder (factor A)> adding amount of adhesive mixtures (factor B)> adding amount of perilla extract powder (factor C). In addition, the K value of factor A, factor B and factor C had the highest value at level 2, level 3 and level 1, respectively. It indicated that the optimal formula compositions were 8% of perilla powder, 40% of adhesive mixtures and 2.5% perilla extract powder. Thus, combined this result with other some preliminary experiments (data not shown), we concluded the optimal formula of perilla chewable tablet and shown in Table 4.
Table. 4 The optimal formula of perilla chewable tablet

| Ingredients              | Weight percentage (%) |
|--------------------------|-----------------------|
| Perilla powder           | 8.0                   |
| Perilla extract powder   | 2.5                   |
| isomaltooligosaccharide  | 20.0                  |
| microcrystalline cellulose | 20.0                 |
| Vitamin C                | 2.0                   |
| sucralose                | 0.1                   |
| Erythritol               | 2.0                   |
| Essence of perilla       | 0.5                   |
| Lactose                  | 44.4                  |
| Magnesium stearate       | 0.5                   |

A complete nutrient analysis of perilla chewable tablet was reported in Table 5. Among all the analyzed nutrients, the content of carbohydrate was the highest, up to 83.1%. As we all know, Vc has good antioxidation function and could lower the risk of cardiovascular disease and cancer [12], \( \text{V}_\text{B2} \) may be beneficial for burns, injuries, diabetes, hypothyroidism, alcoholism, light sensitivity, cataracts and so on [13], and \( \beta \)-carotene is helpful for preventing cancer, cardiovascular diseases, photosensitivity disorders, age related macular degeneration and so on [14]. Results from nutrient analysis showed that perilla chewable tablet contained 4.69 mg/100g of Vc, 0.16 mg/100g of \( \text{V}_\text{B2} \), and 3.2 (\( \mu \)g/100g) of \( \beta \)-carotene. It suggested nutrients preserved in perilla chewable tablet might exert certain health effects. Moreover, the content of Ca was high up to 18.43 mg/100g, and the content of \( \text{V}_\text{D3} \), which can promote the body's absorption of Ca and mainly come from animals [15], was also found in the perilla chewable tablet and its content was up to 0.055 mg/100g. These results indicated that perilla chewable tablet could be served as a new kind of good calcium supplements.

Table. 5 Nutrient analysis of perilla chewable tablets

| Nutrient     | Content (%) | Nutrient   | Content (mg/100g) |
|--------------|-------------|------------|-------------------|
| Protein      | 1.89        | Calorie    | 1501 (kJ/100g)    |
| Fat          | 1.53        | \( \text{V}_\text{D} \) | 0.055 (mg/100g)   |
| Coarse fibre | 3.56        | \( \text{V}_\text{B2} \) | 0.16 (mg/100g)    |
| Ash          | 4.56        | \( \beta \)-carotene | 3.2 (\( \mu \)g/100g) |
| Carbohydrate | 83.1        | \( \text{V}_\text{K1} \) | 23.5 (\( \mu \)g/100g) |
| Moisture     | 5.38        | \( \text{V}_\text{C} \) | 4.69 (mg/100g)    |
|              |             | Ca         | 18.43             |
|              |             | Fe         | 0.732             |
|              |             | Zn         | 0.263             |
|              |             | Mg         | 3.92              |
|              |             | Mn         | 0.18              |
|              |             | Cu         | 0.36              |

4. Conclusion

Perilla, which is the homology of medicine and food, has very high exploitation value. Our study successfully established a kind of preparation technique of perilla chewable tablet, and the optimum
product formula gained by orthogonal test was determined as follows: 8% perilla powder, 2.5% perilla extract powder, 20% isomaltooligosaccharide, 20% microcrystalline cellulose, 44.4% lactose, 0.5% essence of perilla, 0.1% sucralose, 2% erythritol, 2% vitamin C, 0.5% magnesium stearate. The complete nutrients of perilla chewable tablets were investigated, and results showed that perilla chewable tablet was rich in essential vitamins and mineral substance, which are good for human health, especially in the promotion of calcium supplementation.

Acknowledgement

This work was supported by the National Natural Science Foundations of China (No.31000814 and No.31171642), the project of agriculture technical achievements transformation from Chinese Ministry of Science and Technology (No. 2011GB2C000008), and the projects from Science and Technology Commission of Shanghai Municipality (No. 11495801600).

References

[1] Zhang H., Huang J.S., Zhao D.H.. Study on the nutritional contents of Parilla, Journal of Hunan University of Arts and Science (Chinese Journal) 2006; 18(1): 49-52.
[2] Guo R., Pittler M.H., Ernst E.. Herbal medicines for the treatment of allergic rhinitis: A systematic review. Annals of Allergy Asthma and Immunology 2007; 99(6): 483-595.
[3] Banno N., Akihisa T., Tokuda H., Yasukawa K., Higashihara H., Ukiya M., et al., Triterpene acids from the leaves of Perilla frutescens and their anti-inflammatory and antitumor promoting effects. Biosci Biotechnol Bioch. 2004; 68(1):85-90.
[4] Ueda H, Yamazaki C., Yamazaki M., Inhibitory effect of Perilla leaf extract and luteolin on mouse skin tumor promotion, Biological and Pharmaceutical Bulletin 2003; 26(4):560-563.
[5] Yamamoto H., Ogawa T., Antimicrobial activity of perilla seed polyphenols against oral pathogenic bacteria, Biosci Biotech Bioch. 2002; 66(4): 921-924.
[6] Kawahata T., Otake T., Mori H., Kojima Y., Oishi I., Oka S., et al.. A novel substance purified from Perilla frutescens Britton inhibits an early stage of HIV-1 replication without blocking viral adsorption, Antiviral Chemistry and Chemotherapy 2002; 13 (5) :283-288.
[7] Du Y.J.. Study on processing technology of oat dietary fiber chewing tablet, Science and Technology of Cereals, Oils and Foods (Chinese Journal). 2006; 14(5): 37-38.
[8] Zhang Q., Zeng F.J., Zeng L.. Study on amino acid chelated calcium milk flavored chewable Tablets. Science and Technology of Food Industry (Chinese Journal) 2007; 27(8):132-134.
[9] Jiang Z.Q., Zou J.H., Xiong W.Y.. Research on preparation technology of natto chewable Tablets, Food research and development (Chinese Journal) 2007; 28(4):128-130.
[10] Wang H.d., Wang M.Y., Li X.b.. Evaluation of the antipyretic activity of Gypsum Fibrosum and its constituents. Asian Journal of Traditional Medicines. 2009; 4(2):82-84.
[11] Ling J.Y., Zhang G.Y., Cui Z.J., Zhang C.K.. Supercritical fluid extraction of quinolizidine alkaloids from Sophora flavescens Ait. and purification by high-speed counter-current chromatography. J Chromatogr A. 2007; 1145:123-127.
[12] Padayatty S.J., Katz A., Wang Y.H., Eck P., Kwon O., Lee J.H., et al.. Vitamin C as an antioxidant: evaluation of its role in disease prevention. J Am Coll Nutr2003; 22(1): 18-35.
[13] Information on http://www.natmedtalk.com/wiki/Vitamin_B2.
[14] Mayne S.T.. Beta-carotene, carotenoids, and disease prevention in humans. The FASEB Journal 1996; 10(7):690-701.
[15] Heaney R.P., Barger-Lux M.J., Dowell M.S., Chen T.C. and Holick M.F.. Calcium absorptive effects of vitamin D and its major metabolites. J. Clin, Endocrinol. Metab. 1997; 82(12):4111-4116.