ORIGINAL ARTICLE

Study on the Technology of Grapefruit Capsules Removement by Enzymatic

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Abstract: Taking grapefruit as the experimental raw material, the fruit kernel integrity and extraction rate were comprehensively evaluated, and the grapefruit enzymatic de-coating process was explored to provide a basis for the industrial production of grapefruit fruit. The enzymatic de-coating process parameters were optimized by orthogonal test. The results showed that the water bath temperature was 40℃, the total amount of pectinase and cellulase was 1.25 mL, Study on the Technology of Grapefruit Capsules Removement by Enzymatic the ratio was 1:3, and the ratio of material to liquid (West) When the ratio of pomelo and mixed enzyme solution was 80g/100mL, the effect of decapsulation was the best. The grapefruit obtained in this case was relatively complete, and the extraction rate reached 93%.

Keywords: Food Science and Engineering; Grapefruit; Capsule; Enzymatic Hydrolysis; Orthogonal Test

Introduction

Grapefruit is also called grapefruit, which combines the advantages of grapefruit and sweet orange into one[1] with soft, juicy and refreshing pulp, fresh 35 aroma, sour taste, bitter taste and hemp tongue taste[2]. Citrus grandis is rich in nutrition and contains a large amount of vitamin P which can enhance the functions of skin and hair pores. Citrus grandis is low in calories and rich in vitamin C, which has a good cosmetic effect and can prevent black spots and finches. Spot, wrinkle and fatigue elimination; citrus grandis is rich in potassium, which can prevent cardiovascular and cerebrovascular diseases and kidney diseases and reduce cholesterol[3] n blood.

Although grapefruit has high nutritional value, it was introduced into China for trial planting around 1940 and has not been popularized so far, only has a few places where[4] is planted. According to the survey, about half of the grapefruit in the world is processed into fruit juice, jam and fruit wine. However, removing capsule coating is an important link in the processing of grapefruit. If not completely removed in the processing process, the freeze-dried finished product will suffer from defects such as capsule coating adhesion, poor sensory quality and rough taste, thus reducing the commercial value of food[5].

At present, acid-base method and enzyme method are mainly used to remove capsular coat. Acid-base method is a traditional method, there are roughly three kinds: one is at 1% the alkali liquor is stirred for 4-5 min at 40℃ and three times of countercurrent static floating alkali liquor are adopted for 15, 10 and 5 min

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respectively. Finally, it was statically floated with 1% citric acid for 5 min with an average water consumption of 1.8-2 L/kg pulp[6-7]. The second is to separate the peeled grapefruit after 0.4 g/100 ml, 27 c hydrochloric acid solution and 0.3 g/ml 45 c potassium hydroxide solution are treated for 30 min.

The third is phosphate alkali method[8]. pomelo is put into phosphate-alkali solution at 55 ℃ . the concentration of sodium tripolyphosphate and sodium hydroxide solution are 0.4 g/100ml and 0.5g /100ml respectively for 4 min. after removal, the pomelo is rinsed with running water[9]. The traditional acid-base method has high valve dispersion rate, large water consumption and high COD content in wastewater, which will produce a large amount of industrial wastewater and seriously pollute the environment. But also increased the cost of wastewater treatment, in addition to the treated pomelo petals there are chemical residues and other hidden dangers[10]. Pectinase and cellulase are mainly used in enzymatic capsulectomy.

The capsule coating is mainly composed of polysaccharide substances such as pectin and cellulose The process of forming and removing capsular coating is mainly to decompose and destroy protopectin to make it into soluble pectin, thus causing disintegration[11-13] of pectin fibronectin composite structure in capsular coating tissue. Enzymatic capsulorhexis technology has the characteristics of full sand sac and complete pomelo petals, with obvious effect, good quality, low valve scattering rate, neat appearance, convenient application, high safety and no pollution to the environment, and is practical and feasible method, therefore, has attracted much attention from the industry[14]. At present, the reports of capsular removal are mainly directed at citrus, and most of them focus on the research of single enzymes such as pectinase and cellulase, which has the problems of too long enzymolysis time, low enzymolysis efficiency, corner wrapping, incomplete capsular removal, etc[15].

There are few reports of grapefruit capsular coating removal. grapefruit capsular coating is thicker and its composition is not completely consistent with citrus. this paper intends to use acid-enzyme two-stage method and single enzyme method to explore the best removal method of grapefruit capsular coating, and to determine the best treatment through single factor test and orthogonal test condition, improving the extraction rate and extraction quality, is of great significance to promote the industrial processing of grapefruit grains.

1. Materials and methods

1.1 Materials and reagents

Grapefruit: Laiyang Lindfeng Agricultural Technology Co., Ltd. Pectinase and Cellulase: Jiangsu Yihaotian Biotechnology Co., Ltd.

1.2 Instruments and equipment

Digital display thermostatic water bath pan, HH-2: electronic balance of Guohua electric appliance co., ltd., 200 g/0.01 g: Shanghai precision instrument co., ltd.

1.3 Test method

To explore the effect of acid-enzyme two-stage method and enzyme treatment alone on dehulling of grapefruit, and to observe the process and effect of dehulling fruit, select the appropriate treatment method, carry out single factor test and orthogonal test, and explore the best conditions for grapefruit capsulizing.

1.4 Test design

Single factor experiments were carried out with water bath temperature, enzyme dosage, enzyme ratio and solid-liquid ratio as indexes respectively to preliminarily determine the effect of each factor on grapefruit capsulizing. Select 35℃, 40℃, 45℃, 50℃, 55℃ for water bath, other conditions are the same as 1.4.2, and explore the best water bath temperature. Under the optimal water bath temperature, the effects of enzyme dosage of 0.1/0.4 ml, 0.2/0.8 ml, 0.25/1 ml, 0.3/1.2 ml and 0.35/1.4 ml on the capsule coating removal effect are set respectively to explore the optimal enzyme dosage. Set the optimal water bath temperature and the optimal enzyme amount to control the ratio of the two enzymes to be 1:1, 1:2, 1:3, 1:4 and 1:5, respectively, and explore the influence of the ratio of the two enzymes on the capsule coating removal effect. Setting the best water bath temperature, the best enzyme amount, and the best enzyme ratio, the material-liquid ratio (grapefruit /enzyme solution) is 100 g/100 ml, 90 g/100 ml, 80 g/100 ml, 70 g/100 ml, 60 g/100 ml and 50 g/100 ml to explore the best material-liquid ratio.

2. Results and analysis

2.1 Acid enzyme treatment results

The experimental results show that the extraction rate of both acids is about 90%, and the extraction time is about 30 min. The fruit grains separated from hydrochloric acid are dim. The capsular collapse effect caused by the decomposition of strong acid is relatively strong, and capsular cells are more broken. After strong acid treatment, long-time running water rinsing is required, which is time-consuming and laborious, and results in waste of water resources and increases the cost of wastewater treatment.

2.2 Enzyme treatment results

When treated with enzyme alone, the extraction rate is about 90%, and the extraction time is 60 min. During the experiment, it was found that the capsular bag was broken down into small pieces bit by bit and the solution was turbid when treated with acid-enzyme, which increased the difficulty of separating the capsular bag from the broken capsular bag. When treated with enzyme alone, the capsule will slowly separate from the fruit grains and fall off in large areas, which is beneficial to the separation of the capsule and the capsule at the later stage. The treated solution is clear, the capsule is relatively complete, and the color and luster remain good. Compared with the acid-enzyme treatment, the separate enzyme treatment takes a little longer to extract, but the fruit grains are more complete, the capsule flaps are full, the flavor and taste are all good, and the water washing time and the sewage treatment cost are reduced. Therefore, only the enzyme method to remove the capsule coating is explored in the following tests.

2.3 Single factor test results of enzyme treatment

When the temperature is 35-45 ℃, the extraction rate. All reached above 90%, but at 35 ℃, the enzyme activity was low, resulting in too long time and incomplete removal of capsule coating. With wrap angle, prolonged soaking also has adverse effects on sensory quality. When the temperature is higher than 50 ℃, the enzyme is inactivated, the capsule coating is not easy to fall off, and the fruit grains are seriously damaged. The removal effect is better and the extraction rate is higher when the temperature is 40 ℃, 45 ℃ and 50 ℃. The removal effect of capsule coating is the best when the temperature is 45 ℃, and the extraction rate is also the highest.

When the ratio of the two enzymes is 1:1, the time consumption is shorter, but the fruit grains are seriously damaged and the extraction rate is lower. Two kinds when the ratio of enzyme is 1:5, it takes a long time and the capsular coat is not completely removed. Therefore, the ratio of the two enzymes was selected as 1:2, 1:3 and 1:4 140 for orthogonal test.

2.4 Effect of material-liquid ratio (ratio of grapefruit to enzyme solution) on peeling effect of grapefruit

It is difficult to stir the grapefruit during the test because it cannot cover the grapefruit, which eventually leads to incomplete removal of the grapefruit capsule. Therefore, the orthogonal test was carried out with the material-liquid ratio of 80 g/100 ml, 70 g/100 ml and 60 g/100 ml.

3. Conclusion

In this article, grapefruit was used as the experimental material, and the integrity and extraction rate of fruit particles were used as the comprehensive evaluation indexes to explore the enzymatic capsulizing process of grapefruit. Through single factor experiment and orthogonal experiment, the technological parameters of enzymatic capsular removal were optimized. The experimental results showed that the best capsular removal effect was achieved when the water bath temperature was 40℃, the total amount of pectinase and cellulase was 1.25ml, and the ratio was 1:3, and the ratio of material to liquid (the ratio of grapefruit and mixed enzyme solution) was 80g/100ml. At this time, the obtained grapefruit grains were relatively complete and the extraction rate reached 93%. After the capsule coating is removed, it exists in the solution together with the pulp, and the pulp is filtered into the feeding barrel by the vibrating screen. The capsule coating is cut off on the vibrating screen due to the large slice type, thus realizing the separation of the capsule coating and the pulp, solving the difficult problem of removing the capsule coating in grapefruit processing enterprises, and being applicable to guiding industrial production.

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