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Raw Ginger Composite Antioxidant with High Efficiency to Extract Vitamin C from Strawberry

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ABSTRACT

Raw ginger was introduced to a series of composite antioxidants. The specimens performed better efficiency than ordinary antioxidants while extracting vitamin C from strawberry. The results suggested that, by employing raw ginger composite antioxidant, the reservation of vitamin C could be 91.63% in washing process and 76.68% in squeezing process respectively. Furthermore, in squeezing process, the reservation of vitamin C reached 84.78% while the concentrate of raw ginger antioxidant was 0.03%. The both deposits performed perfect synergy effectively. Raw ginger composite antioxidant could be the well agent to extract vitamin C from fruit.

Keywords: Raw Ginger; Composite Antioxidant; Synergy Effective; Strawberry; Vitamin C

1. Introduction

Vitamin was one of the most important nourishment for human beings. However, vitamin was synthesized by photosynthesis. Animals' body could not generate vitamin. Thus, animals can only seize vitamin from plant directly or indirectly by food chain. Since our dishes were almost cooked, vitamin was mostly destroyed by heating, making malnutrition prevalent. Hence, extract vitamin became an important project.

Strawberry inhabits rich vitamin C. It belongs to friaries, rosaceae, and ligneous plant. The fruits were colorful, fruity and sweet berry. However, the fresh strawberry was hard to reserve due to its feeble body. It is necessary to extract nutrition from the fruit. As a task, how to efficiently reserve the vitamin was put to an agenda. Researchers paid their attention to the project in the past decades. Nowadays, because vitamin C was fragile, antioxidant with no poison, no side-effect was introduced to process strawberry [1,2]. Amongst, raw ginger composite antioxidant had not been treated.

Ginger mainly grows in Asia. Scientists applied ginger as antioxidant and already got the expected results [3,4]. Tea could also be antioxidant. After mixing ginger and tea deposit, the association of these two component raised by comparing the effect of ordinary food additive EDTA and disodium hydrogen phosphate, either be the sole ginger deposit and tea deposit. Supplying the raw ginger composite antioxidant to washing and squeezing strawberry, the reservation of vitamin C got up.

2. Experiments

1) *Agencies and instruments*

Agencies: fresh strawberry, ginger powder, tea, vitamin C, EDTA, Na_2HPO_4, citric acid, metaphosphoric acid.

Instruments: microwave oven, 721 photometer, UV-2401 photometer, RE-S2 spinning evaporimeter, DKB-501 thermostat water cistern, DF110 electric balance.

2) *Processing*

a) Preparation of ginger composite antioxidants

Ginger deposits: 5.00 g ginger powder was dispersed in 80% ethanol solution. The fluid was refluxed in the Soxhlet extractor till the liquid exhibited colorless. After filtering, the extracted liquid was enriched by a spinning evaporimeter. Dry and weigh the deposit, then mingle part outcome in 50% ethanol solution to obtain the necessary concentrate ginger solution.

Tea deposits: Avoiding ray, 15.00 g tea was dispersed in 300 ml, 65% ethanol solution at room temperature for 3 days. After filtering, the tawny extracted liquid was enriched by a spinning evaporimeter. Dry and weigh the deposit, then mingle part outcome in 50% ethanol solu-

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tion to obtain the necessary concentrate tea solution.

Ginger composite antioxidants: According to **Tables 1-3**, the solution with necessary content were formulated with above ginger and tea deposits.

Table 1. Reservation of vitamin C in washing process at room temperature.

Antioxidant	Concentrate/ %	5 min/%	20 min/%	40 min/%	60 min/%
Ginger deposits	0.01	86.82	86.31	74.12	69.55
	0.02	87.43	86.75	83.83	80.62
	0.03	87.92	87.56	85.73	82.26
Tea deposits	0.01	86.53	86.15	73.60	67.50
	0.02	86.97	86.64	83.92	81.07
	0.03	87.42	87.18	85.46	83.39
Ginger and tea deposits	0.01	90.26	90.15	88.51	86.74
	0.02	98.64	98.24	96.25	90.85
	0.03	98.91	98.76	97.18	91.63
EDTA	0.01	86.49	79.20	78.85	70.65
	0.02	86.73	79.83	79.52	77.19
	0.03	87.36	81.56	80.05	78.23
Na_2HPO_4	0.2	86.32	77.25	72.56	67.30
	0.4	86.51	77.29	72.64	67.52
	0.6	86.73	77.30	72.67	67.51
Pure water	-	86.25	76.13	71.58	66.24

Table 2. Reservation of vitamin C in squeezing at room temperature.

Antioxidants	Concentrate/%	Vc reservation ration/%
Ginger deposit	0.01	43.15
	0.02	54.67
	0.03	56.75
Tea deposit	0.01	42.84
	0.02	53.72
	0.03	55.98
Ginger and tea deposit	0.01	56.16
	0.02	72.80
	0.03	76.68
EDTA	0.01	49.76
	0.02	53.57
	0.03	54.41
Na_2HPO_4	0.01	37.87
	0.02	38.35
	0.03	38.96
Pure water	-	37.56

b) Reservation of vitamin C in washing progress

Matured strawberry was chosen no damage and with the same size to wash by different antioxidant solution in 5 minutes. The content of vitamin C was determined according to the time table at room temperature. According to **Table 1**, the concentrate of antioxidant was 0.01%, 0.02%, 0.03% respectively. And the data were the average value among 3 tests. In contrast, **Table 1** also inhabited the effect of pure water.

c) Reservation of vitamin C in squeezing progress

After washing by pure water, matured strawberry was chosen no damage and with the same size to squeeze while different antioxidants were introduced. The squeezing time and speed were manipulated the same. Strawberry ade was poured in beaker and stirred. 90 minutes later, filter the liquid with bilayer etamine and determined the content of vitamin C. **Table 2** and **Figure 1** exhibit the average value amongst 3 tests.

d) Ultraviolet-visible spectrum admeasurements of deposits

Diluting the deposits of ginger and tea by carbinol, ultra-violet-visible spectrum absorption was measured. **Figures 2** and **3** illustrated the results.

3. Results and Discussion

1) *Determination of vitamin C*

The determination of vitamin C adopted the Ultravio

Table 3. Specimen of ginger compound antioxidant.

Number	1	2	3	4	5	6	7
Ginger deposits/mg	40	36	34	32	30	28	26
Tea deposits/mg	0	4	6	8	10	12	14
Number	**8**	**9**	**10**	**11**	**12**	**13**	
Ginger deposits/mg	24	22	20	23.5	23	22.5	
Tea deposits/mg	16	18	20	16.5	17	17.5	

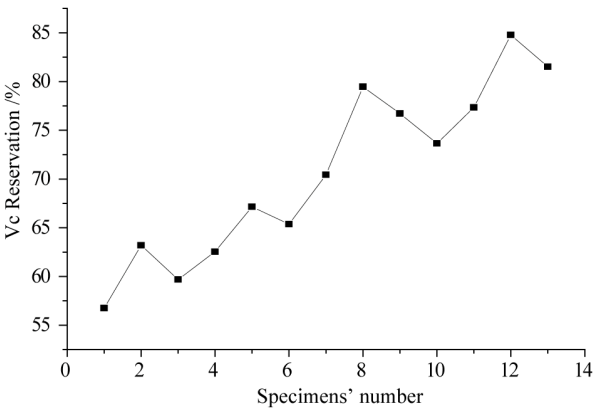

Figure 1. V_c reservation in squeezing process.

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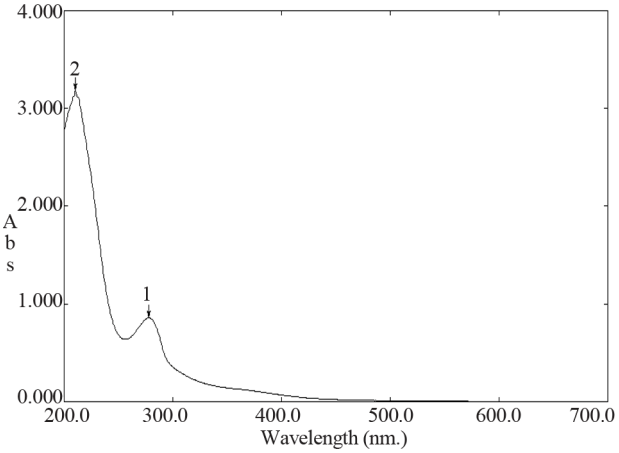

Figure 2. UV-visible absorption spectrum of methanol ginger.

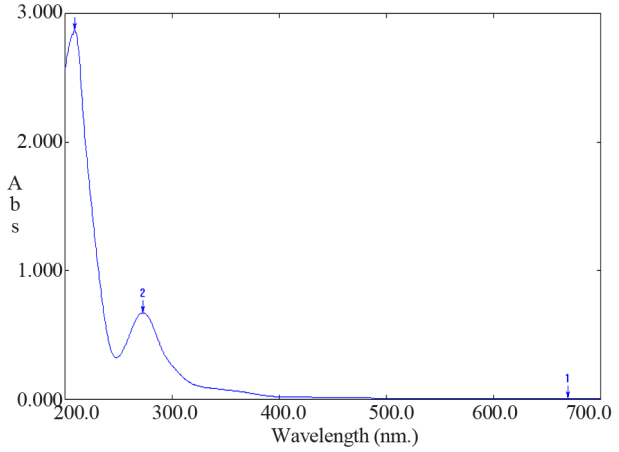

Figure 3. UV-visible absorption spectrum of tea.

let Absorption Admeasurements [5]. The calculation equation is formula (1).

$$Y = 0.00547 + 0.04458X \quad (1)$$

where, X refers to concentrate of ascorbic acid (ug/ml), Y refers to the gap ΔA of absorption between solution and alkali specimen.

In place of standard ascorbic acid solution, concentrate of vitamin C could be reckoned according Formula 1. Following, the reservation of vitamin C was calculated.

$$R_{Vc} = C_{Vc}/C_{Vc0} \quad (2)$$

where, R_{Vc} refers to the reservation of vitamin C, C_{Vc} refers to the content of vitamin C after processing, C_{Vc0} refers to the original content of vitamin C which determined immediately following the washing process.

2) *Reservation of vitamin C in washing process at room temperature*

According to **Table 1**, after washing strawberry at 25 degree for 5 minutes, agency containing ginger deposit usually performed better reservation than others. Contrast to pure water, the reservation of vitamin C washed by composite ginger antioxidant was 4.01% - 12.66% higher. As long as the standing time prolonged, all the list antioxidant took effect. While the specimens were laid up to 60 minutes, antioxidant with ginger and tea deposit took the best effect. The reservation of vitamin C was 20.50% - 25.39% higher than those washed by pure water and 13.40% - 16.09% higher than those washed by EDTA.

Ginger deposit, tea deposit as well as EDTA somehow took the similar roles in the washing process to reserve vitamin C. Na_2HPO_4 injected even few enhancement. Furthermore, the reservation hardly varied according to the concentrate of Na_2HPO_4. It suggested that Na_2HPO_4 not help preserving vitamin C. However, ginger and tea composite antioxidant took the greatest effective, proving that ginger deposit associate tea deposit to reserve vitamin C as antioxidant. When the concentrate of composite antioxidant was 0.02% - 0.03%, the reservation of vitamin C was the highest in washing process.

3) *Reservation of vitamin C in squeezing process*

In squeezing process, according to **Table 2**, ginger deposit, tea deposit, composite antioxidant and EDTA brought obviously higher reservation of vitamin C, while Na_2HPO_4 took almost no effect. Amongst them, composite antioxidant performed perfect. By introducing ginger and tea composite antioxidant, concentrate of vitamin C in the squeezed juice enhanced 18.60% - 39.24%, also 6.4% - 22.27% higher than that introduced EDTA. When the concentrate of composite antioxidant was 0.02% - 0.03%, the reservation of vitamin C was the highest in squeezing process.

4) *Reservation of vitamin C related to the content of ginger—tea antioxidant*

According to **Table 3**, a serial of composite antioxidant were prepared. All specimens had the same mass while the contents of ginger deposit and tea composite varied. Each one was resolved 0.03% mass concentrate in water. After adding the solution in squeezing process, the content of vitamin C was determined by formula (1) and formula (2). **Figure 1** exhibited the measurement.

Figure 1 perceived that the sequence of reservation was 12 > 13 > 8 > 11 > 9 > 10 > 7 > 5 > 6 > 2 > 4 > 3 > 1. That meant that binary antioxidant applied more action than solo antioxidant to the reservation. While the ginger deposit was 23 mg and tea deposit was 17 mg, reservation of vitamin C reached the highest 84.78%.

5) *UV-visible spectrum determination of ginger deposits*

Figure 2 was the UV-visible absorption spectrum of methanol ginger solution. At the wavelength between 200 nm and 400 nm, there exist two character absorption peaks. 1 is around 280 nm, and 2 is around 230 nm. These two peaks were in accordance with raw flavone [6], and also similar to the pure gingerose [7], strongly rec-

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ommend that flavone and gingerose alike exist in ginger deposit.

Figure 3 was the UV-visible absorption spectrum of tea solution. As **Figure 2**, at the wavelength between 200 nm and 400 nm, there also exist two character absorption peaks. They were around 210 nm and 273 nm respectively. These two peaks were in accordance with tea polyphenols [8], recommend that tea polyphenols alike exist in tea deposit.

6) *Anti-oxide principle*

Ginger contains zingiberol, zingiberene, bisabolene, ar-curcumene *α*-, *β*-farnesene, linalool, flavone and *et al.* [9]. These substances all possess phenol-oxhydryl. The main ingredient of tea deposit is tea polyphenols. It also possesses flavonoid compounds [10]. Since the phenol-oxhydryl activated to supply hydrogen, vitamin C kept deoxidation in the processes. In solution, EDTA decomposed into anion H_2Y^{2-}, which abstracted 2^+ and 3^+ cation, forming steady compound MY. Thus, vitamin C was protected to be oxidated due to the lack of metal cation. Further investigations included that hydro-bond existed between vitamin C and EDTA, making the vitamin keep the original structure [9].

Further study claimed that different antioxidant took on different characteristics. In strawberry, lots of hydrogen peroxide, various mineral elements and H_2O_2 not only harmed cell, but also initiated peroxidation, producing various living radicals, accelerating the oxidation of vitamin C. For ginger composite antioxidant, ginger ingredient and tea ingredient still cooperate to clear living radicals, enhanced the antioxidating action. The detail principle was investigated so far.

4. Conclusion

Ginger composite antioxidant was prepared and the effectiveness to reserve vitamin C in washing and squeezeing process was investigated. By comparing binary system and solo system, it could be inferred that tea deposit associated ginger deposit to reserve vitamin in both processes. While a mass of ginger deposit and tea deposit were 23 mg and 17 mg respectively, and the concentrate of antioxidant was 0.03%, the reservation of vitamin C reached the highest 84.78%.

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