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Technical Factors Affecting To Pickle Shallot (*Allium Ascalonicum*) Fermentation

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Abstract.
Shallot (*Allium ascalonicum* L.) is a vegetable with high economic value. This plant has been used as an additive in foods. The preservation of shallot is an important issue for both farmers and people who use shallot as a dietary additive, because of its unique fragrance. Fermentation is one of the most convenient technologies for the production of shelf stable food product. The objective of this study was to evaluate different aspects affecting to the fermentation of shallots such as concentration of $CaCl_2$, temperature and time for blanching; effect of ratio *Lactobacilus plantarum* to the antioxidant of fermented shallot. Results showed that shallot should be blanched in hot water 95°C in 20 seconds with the present of 4.0% $CaCl_2$. Moreover, the fermentation process for pickle Shallots had the best antioxidant by *Lactobacilus plantarum* at ratio 1.5 x 10^8 cells/ml. Blanching and fermentation had significantly affected to antioxidant capacity and firmness of pickle shallot.

Keywords: *Shallot, pickle, fermentation, blanching, Lactobacilus plantarum, antioxidant*

I. INTRODUCTION

Shallots (*Allium ascalonicum*) is a perennial vegetable species. Flowering and formation of shallot bulbs are influenced by some factors, including variety, fertilization and pollination success.[1] Shallot produces a cluster of bulbs from a single planted bulb. Bulbs of shallot (*Allium ascalonicum*) contain saponin, sapogenine, ajoene and flavonoid extracts.[2] The flavonoid fraction of *A.ascalonicum* bulbs had remarkable antibacterial and anticancer properties.[3, 4, 5, 6] Extracts of shallot by-product meal were more effective as antibacterial agent than those of shallot by-product juice extract, whereas inhibitory effect was found more effective on Gram negative bacteria than the Gram positive bacteria.[7] *Allium ascalonicum* had numerous therapeutic effects and health-enhancing properties such as cancer prevention.[8, 9] Shallot harvest handling must be done immediately after harvest because these commodity are easily damaged.[10] In order to preserve the nutrients in shallots, after harvest, various protocols, including incubation, drying or lyophilization of the shallot are developed.[11]

The health and nutritional benefits of shallot have led to their increased demand and hence production. Not many researches mentioned to shallot fermentation. Increased production is accompanied by increase in postharvest losses due to their perishable nature. Due to the relatively short postharvest life in fresh form, shallot can be converted to shelf stable forms through processing. One of the most commonly used processing methods is fermentation. The objective of this study was to evaluate different aspects affecting to the fermentation of shallot such as concentration of $CaCl_2$, temperature and time for blanching; effect of ratio *Lactobacilus plantarum* to the antioxidant of pickle shallot.

II. MATERIALS AND METHOD

2.1 Material

We collected shallots in Soc Trang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. After collecting, they must be conveyed to laboratory within 4 hours for experiments. They were washed under tap water to remove foreign matters. Besides shallot, we also used aother material during the research such as $CaCl_2$. Lab utensils and equipments included digital weight balance, fermentor.

Figure 1. Shallot (*Allium ascalonicum)*

2.2 Researching procedure

2.2.1 Antioxidant in raw shallot

Total 9 samples of raw shallots were used to measure the antioxidant content (mmol TE/g) in raw material. The antioxidant activity of raw shallot was evaluated by FRAP (Ferric Reducing Ability of Plasma).[12]

2.2.2 Effect of $CaCl_2$ concentration for blanching to the antioxidant of fermented shallot

Shallots were blanched with $CaCl_2$ in different $CaCl_2$ concentrations (0%, 1.0%, 2.0%, 3.0%, 4.0%, 5.0%, 6.0%) in water at 100°C for 10 seconds. *Lactobacillus acidophilus* was added at ratio 1.0 x 10^8 cells/ml. The fermentation process was carried out at ambient temperature for 7 days. Antioxidant activity (mmol TE/g) and firmness (sensory score) were analyzed in the samples to verify the appropriate $CaCl_2$ concentration for blanching.

2.2.3 Effect of temperature and time for blanching to the antioxidant of fermented shallot

Shallots were blanched with $CaCl_2$ in 4.0% of $CaCl_2$ in water at different time and temperature (100°C for 10 seconds, 95°C for 20 seconds, 90°C for 30 seconds and 85°C for 40 seconds). *Lactobacillus acidophilus* was added at ratio 1.0 x 10^8 cells/ml. The fermentation process was carried out at ambient temperature for 7 days. Antioxidant activity was analyzed in the samples to verify the appropriate temperature and time for blanching.

2.2.4 Effect of ratio Lactobacilus plantarum to the antioxidant of fermented shallot

Shallots were blanched with $CaCl_2$ 4.0% in water at 95°C for 20 seconds. *Lactobacillus acidophilus* was added for the fermentation with different ratio 0; 0.5 x 10^8; 1.0x 10^8; 1.5x 10^8; 2.0x 10^8 cells/ml. Fermentation process was carried out at ambient temperature for 7 days. Antioxidant activity was analyzed in the samples to verify the appropriate ratio of *Lactobacilus plantarum* for fermentation.

2.2.5 Quality assessment of the fermented shallot

Sensory score of fermented shallot was evaluated a group of panelists. They were required to evaluate the odour, colour, taste, sweetness and overall acceptance using the 9-point hedonic scale (1 = dislike extremely, 9 = like extremely). The antioxidant activity of fermented shallot was evaluated by FRAP (Ferric Reducing Ability of Plasma).[12]

2.3 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT) Statistical analysis was performed by the Startgraphics.

III. RESULT & DISCUSSION

3.1 Antioxidant in raw shallot

Total 9 samples of raw shallots were used to measure the antioxidant content (mmol TE/g) in raw material. The antioxidant activity of raw shallot was evaluated. Results were depicted in table 1.

Before lactic fermentation, the red onions contained 297.4 mg of total quercetin (Q) per kg wet weight, which consisted of 58.3%, 41.6% and 0.1% in quercetin diglucoside (Qdg), quercetin monoglucoside (Qmg) and free Q, respectively.[13] Polyphenol content was highest in fresh onions, and much lower in the material subjected marinating process.[14]

3.2 Effect of $CaCl_2$ concentration for blanching to the antioxidant and firmness of fermented shallot

Shallots were blanched with $CaCl_2$ in different $CaCl_2$ concentrations (0%, 1.0%, 2.0%, 3.0%, 4.0%, 5.0%, 6.0%) in water at 100°C for 10 seconds. *Lactobacillus acidophilus* was added at ratio 1.0 x 10^8 cells/ml. The fermentation process was carried out at ambient temperature for 7 days. Antioxidant activity and firmness (sensory score) were evaluated in the samples to verify the appropriate $CaCl_2$ concentration for blanching. Results were elaborated in table 2. From table 2, the antioxidant content was not significantly different by $CaCl_2$ concentration. However, the firmness (sensory score) of pickle shallot had significantly different by $CaCl_2$ concentration. Among these treatments, pickle shallot had the highest firmness by treatment at 4.0% of $CaCl_2$. So this value was selected for further experiments.

Blanching process led to significant reduction of the antioxidant activity and thiosulfinate contents in Garlic (*Allium sativum* L.). The antioxidant activity showed a significant correlation with thiosulfinates and both the antioxidant activity and thiosulfinate contents decreased with increasing blanching time.[15]

3.3 Effect of temperature and time for blanching to the antioxidant and firmness of fermented shallot

Shallots were blanched with $CaCl_2$ in 4.0% of $CaCl_2$ in water at different time and temperature (100°C for 10 seconds, 95°C for 20 seconds, 90°C for 30 seconds and 85°C for 40 seconds). *Lactobacillus acidophilus* was added at ratio 1.0 x 10^8 cells/ml. The fermentation process was carried out at ambient temperature for 7 days Antioxidant activity and firmness (sensory score) were evaluated in the samples to verify the appropriate temperature and time for blanching. Results were elaborated in table 3. From table 3, the shallot should be blanched at 95°C in 20 seconds to get the highest antioxidant and firmness of pickle product. So these values were selected for further experiments.

Table 1. Antioxidant (mmol TE/g) in raw shallot

Sample	#1	#2	#3	#4	#5	#6	#7	#8	#9	Average
Antioxidant (mmol TE/g)	58.41	58.45	58.50	58.47	58.49	58.51	58.52	58.48	58.60	58.48 ±0.02

Table 2. Effect of $CaCl_2$ concentration for blanching to the antioxidant (mmol TE/g) and firmness (sensory score) of fermented shallot

$CaCl_2$ (%)	0%	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%
Antioxidant (mmol TE/g)	79.40 $\pm0.02^{b}$	79.46 $\pm0.01^{ab}$	79.49 $\pm0.01^{ab}$	79.50 $\pm0.02^{ab}$	**79.55 $\pm0.00^{a}$**	79.57 $\pm0.03^{a}$	79.58 $\pm0.01^{a}$
Firmness (sensory score)	4.21 $\pm0.03^{d}$	5.31 $\pm0.02^{c}$	6.44 $\pm0.01^{bc}$	6.79 $\pm0.02^{b}$	**7.22 $\pm0.03^{a}$**	7.25 $\pm0.02^{a}$	7.27 $\pm0.01^{a}$

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 3. Effect of temperature and time for blanching to the antioxidant and firmness of fermented shallot

Blanching	100°C, 10 seconds	95°C, 20 seconds	90°C, 30 seconds	85°C, 40 seconds
Antioxidant (mmol TE/g)	79.55 ± 0.01^{b}	**86.40 ± 0.02^{a}**	77.33 ± 0.01^{c}	71.21 ± 0.01^{d}
Firmness (sensory score)	7.22 ± 0.03^{c}	**8.11 ± 0.01^{a}**	7.89 ± 0.03^{b}	6.11 ± 0.02^{d}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 4. Effect of *Lactobacilus plantarum* ratio to the antioxidant of fermented shallot

***Lactobacilus plantarum* (cells/ml)**	**0**	**0.5 x 10^8**	**1.0 x 10^8**	**1.5 x 10^8**	**2.0 x 10^8**
Antioxidant (mmol TE/g)	57.67±0.01^c	78.35±0.02^b	86.40±0.02^{ab}	**89.41±0.02^a**	89.45±0.0^a
Firmness (sensory score)	6.56±0.02^c	7.19±0.02^b	8.11±0.01^{ab}	**8.65±0.02^a**	8.66±0.00^a

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

The possibilities for industrial processing of pickled onion with attractive sensory properties including flavour, colour, drained weight, texture, flavonoids after blanching, packing and cool storage was studied.[16]

3.4 Effect of *Lactobacilus plantarum* ratio to the antioxidant of fermented shallot

Shallots were blanched with $CaCl_2$ 4.0% in water at 95^{o}C for 20 seconds. *Lactobacillus acidophilus* was added for the fermentation with different ratio 0; 0.5 x 10^8; 1.0 x 10^8; 1.5 x 10^8; 2.0 x 10^8 cells/ml. Fermentation process was carried out at ambient temperature for 7 days. Antioxidant activity was analyzed in the samples to verify the appropriate ratio of *Lactobacilus plantarum* for fermentation. Results were elaborated in table 4. From table 4, the shallot should be fermented at 1.5 x 10^8 cells/ml of *Lactobacillus plantarum* to get the highest antioxidant in pickle product. So this value was selected for fermentation.

The fermentation process softened the structure of fruits and vegetables, making phenolic easily be extracted. Lactic acid fermentation increased the antioxidant activity than fermented material before. When adding lactic acid bacteria, lactic acid bacteria can produce β-galactosidase, catalyses the production of polyphenol compounds.[16] Fermentation of red onions inoculated with *Lactobacillus plantarum* S1 (starter treatment) resulted in acid production to pH 4.5, after 48h of incubation at 19^{o}C which has proven to be adequate for proper preservation. The bacterial population was about 10^8 CFU mL^{-1} of brine after 3 days in three different treatments.[17] For the starter treatment, quercetin diglucoside decreased to 41.8% and 18.3% at 48 and 72h, respectively, and a substantial amount of free total quercetin had accumulated. The fermentation substantially increased the proportion of quercetin monoglucoside, which may have a positive effect as fractions containing higher ratios of quercetin monoglucoside to quercetin diglucoside have been reported to have higher antioxidant activity.[13] The lacto-fermented onion extracts in all species were found to have potent anticancer and antibacterial activity compared to natural fermented onions.[18]

IV. CONCLUSION

Shallot (*Allium ascalonium*) has many benefits for human life, in term of its economic value as well as spices or flavoring dishes and health. Lacto-fermented shallot might be a good candidate against breast cancer cells. This research investigated several aspects affecting to the pickling of shallot. By this approach, added value of shallot could be enhanced. Shallot is preferred to pickle by consumers for their good culinary qualities, such as high pungency and unique flavour.

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