



## Various Factors Affected the Production of Pickled Chinese Jiaotou (*Allium Chinense*)

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### Abstract

Chinese jiaotou is fresh during the harvesting season but perishable under the prevailing conditions of temperature and humidity as well as lack of adequate storage facilities. An alternative approach of preserving surplus Chinese jiaotou could be fermented to pickle products. Preservation of the Chinese jiaotou by lactic fermentation can eliminate the undesired taste and improve flavor of the vegetable. Therefore we explored a lactic fermentation from Chinese jiaotou by focusing on the effect of different parameters such as salt soaking concentration, sun drying time and CaCl<sub>2</sub> soaking as pre-treatment; sugar concentration and fermentation time to physicochemical, microbial and sensory characteristics of pickled Chinese jiaotou. Experimental results revealed that 15% salt is soaking, sun drying in 6 hours, 0.4% CaCl<sub>2</sub> soaking as pre-treatment for raw Chinese jiaotou; then 6% sugar in 21 days of fermentation was appropriated to get a pleasant pickled Chinese jiaotou quality. Chinese jiaotou pickles are considered as one of the health supplements.

**Keywords:** Chinese jiaotou, Pickle, Lactic fermentation, Soaking, Drying, Sugar, Salt.

### Introduction

Chinese jiaotou (*Allium chinense*) is a commercially important plant species. It's known for their creation of steroid saponins, as well as organosulfur compounds [1]. The cytotoxic substance of *A. chinense* saponins affected tumor inhibition action and effectively protected the liver from cancer [2]. Laxogenin extracted from *Allium chinense* was proven to have an antitumor-promoting activity in a two-stage lung carcinogenesis [3].

*A. chinense* showed notable antioxidant activity, and its high-dose essential-oil extract both significantly reduced serum and hepatic total cholesterol, triglyceride, and lowdensity lipoprotein levels and increased serum high-density lipoprotein levels [4].

Pickling is one of the ancient ways of food preservation, and it was a possible way of preserving the foods, especially seasonal foods, before the invention of modern preservative machines like the refrigerator. Pickle is the good source of antioxidants, probiotics, vitamins (vitamin C, A, K, and folate), and minerals (iron, calcium, and potassium).

The fermented vegetables or pickle products made with characterized probiotic strain confirms the supplementation of probiotics to the consumers [5]. Chinese jiaotou is an underutilized vegetable crop and still now there is very limited research available regarding to processing of this vegetable into value added product.

Fermentation of *Allium chinense* bulbs was carried out with *Lactobacillus plantarum* [6]. The Chinese jiaotou vegetable, which typically has high fermentable sugar composition, could be exploited as a substrate for lactic fermentation. Therefore, we utilized this vegetable as substrate for lactic fermentation. We focused on the effect of different parameters such as blanching time and temperature as pre-treatment, salt concentration, fermentation time to physicochemical, microbial and sensory characteristics of pickled Chinese jiaotou.

## Material & Method

### Material



Figure 1: Chinese jiaotou (*Allium chinense*) bulb

### Research Method

#### Effect of Salt Soaking Concentration to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were pre-treated by salt soaking with different concentration (5%, 10%, 15%, 20%). Effectiveness of salt soaking concentration in Chinese jiaotou fermentation was evaluated on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score.

#### Effect of Sun Drying Time to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were pre-treated by sun drying in different duration (2, 4, 6, 8 hours). Effectiveness of sun drying time in Chinese jiaotou fermentation was evaluated on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score.

#### Effect of CaCl<sub>2</sub> Concentration in soaking to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou were cultivated and collected from Vinh Chau district, Soc Trang province, Vietnam. They must be cultivated following VietGAP without pesticide and fertilizer residue to ensure food safety. After harvesting, they must be conveyed to laboratory within 8 hours for experiments. Apart from collecting Chinese jiaotou, we also used other materials such as sugar, NaCl, CaCl<sub>2</sub>, NaOH, phenolphthalein, phosphate buffer, MRS (de Man, Rogosa, and Sharpe)-agar. Lab utensils and equipments included knife, weight balance, cooker, fermentation vessel, pH meter, buret, stomacher, colony counter, micropipettor, incubator.

Chinese jiaotou bulbs were soaked with different CaCl<sub>2</sub> concentration (0.2%, 0.3%, 0.4%, 0.5%). Effectiveness of CaCl<sub>2</sub> soaking concentration in Chinese jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score.

#### Effect of Sugar Concentration in Fermentation to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were fermented with different sugar concentration (2%, 4%, 6%, 8%). Effectiveness of sugar concentration in Chinese jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score.

#### Effect of Fermentation Time to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were fermented with different fermentation time (7, 14, 21, 28 days). Effectiveness of fermentation time in Chinese jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score.

**Physicochemical, Microbial, Sensory Evaluation**

The measurement of pH values were performed using pH meter. The total acidity was determined by titrating 10 ml of pickle extract in 50 ml Erlenmeyer flask using 0.1N NaOH and 1% phenolphthalein as the indicator. The total acidity is expressed as lactic acid (AOAC, 2000). Plate count of lactic acid bacteria were conducted following the method as described by Hadjioetomo (1993), 10 ml of fermented fluid were diluted in 90 ml phosphate buffer and 1 ml were then pipetted onto MRS (de Man, Rogosa, and Sharpe)-agar and incubated at 37°C for 2 days before counting the colony formed. Sensory score was based on 9-point hedonic scale.

**Statistical Analysis**

Data were statistically summarized by Statgraphics Centurion XVI.

**Result & Discussion**

**Effect of Salt Soaking Concentration to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou**

In the pickling industry, salt has historically been used for directing the fermentation of cucumbers, radishes, and carrots [7, 10]. Sodium chloride is an essential in food as it improves the preservative, technological and sensory quality of food [11]. NaCl is one of the most commonly employed agents for food conservation, allowing considerable increase in storage time by reducing water activity [12]. Chinese jiaotou bulbs were pre-treated by salt soaking with different concentration (5%, 10%, 15%, 20%).

Effectiveness of salt soaking concentration in chinese jiaotou fermentation was evaluated on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score. Results were depicted in Table 1. It's clearly noticed that 15% salt in soaking was optimal for chinese jiaotou fermentation. So we selected this value for next experiments.

**Table 1: Salt soaking concentration to physicochemical, microbial and sensory characteristics of pickled chinese jiaotou**

Salt soaking concentration (%)	pH	Total acidity (%)	Lactic acid bacteria (cfu/ml)	Sensory score
5	3.39±0.02 <sup>a</sup>	0.80±0.00 <sup>b</sup>	6.02 x 10 <sup>6</sup> ±0.01 <sup>b</sup>	5.11±0.02 <sup>b</sup>
10	3.35±0.01 <sup>ab</sup>	0.83±0.01 <sup>ab</sup>	6.17 x 10 <sup>6</sup> ±0.02 <sup>ab</sup>	5.42±0.01 <sup>ab</sup>
15	3.31±0.00 <sup>a</sup>	0.89±0.01 <sup>a</sup>	6.31 x 10 <sup>6</sup> ±0.01 <sup>a</sup>	5.64±0.01 <sup>a</sup>
20	3.32±0.00 <sup>ab</sup>	0.81±0.02 <sup>ab</sup>	6.09 x 10 <sup>6</sup> ±0.00 <sup>ab</sup>	5.20±0.00 <sup>ab</sup>

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%)

**Effect of sun drying time to physicochemical, microbial and sensory characteristics of pickled Chinese jiaotou**

Chinese jiaotou bulbs were pre-treated by sun drying in different duration (2, 4, 6, 8 hours). Effectiveness of sun drying time in

chinese jiaotou fermentation was evaluated on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score. Results were depicted in Table 2. It's clearly noticed that 6 hours in sun drying was optimal for chinese jiaotou fermentation. So we selected this value for next experiments.

**Table 2: Sun drying time to physicochemical, microbial and sensory characteristics of pickled chinese jiaotou**

Sun drying time (hours)	pH	Total acidity (%)	Lactic acid bacteria (cfu/ml)	Sensory score
2	3.31±0.00 <sup>a</sup>	0.89±0.01 <sup>b</sup>	6.31 x 10 <sup>6</sup> ±0.01 <sup>b</sup>	5.64±0.01 <sup>ab</sup>
4	3.30±0.01 <sup>ab</sup>	0.92±0.01 <sup>ab</sup>	6.42 x 10 <sup>6</sup> ±0.02 <sup>ab</sup>	5.79±0.03 <sup>ab</sup>
6	<b>3.29±0.01<sup>ab</sup></b>	<b>0.96±0.01<sup>ab</sup></b>	<b>6.65 x 10<sup>6</sup>±0.01<sup>ab</sup></b>	<b>5.85±0.02<sup>a</sup></b>
8	3.27±0.03 <sup>b</sup>	0.97±0.02 <sup>a</sup>	6.70 x 10 <sup>6</sup> ±0.00 <sup>a</sup>	5.30±0.01 <sup>b</sup>

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%)

### Effect of CaCl<sub>2</sub> Concentration in Soaking to Physicochemical, microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were soaked with different CaCl<sub>2</sub> concentration (0.2%, 0.3%, 0.4%, 0.5%). Effectiveness of CaCl<sub>2</sub> soaking

concentration in chinese jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score. Results were depicted in Table 3. It's clearly noticed that soaking 0.4% CaCl<sub>2</sub> was optimal for chinese jiaotou fermentation. So we selected this value for next experiments.

**Table 3: CaCl<sub>2</sub> concentration (%) to physicochemical, microbial and sensory characteristics of pickled chinese jiaotou**

CaCl <sub>2</sub> concentration (%)	pH	Total acidity (%)	Lactic acid bacteria (cfu/ml)	Sensory score
0.2	3.29±0.01 <sup>a</sup>	0.96±0.01 <sup>b</sup>	6.65 x 10 <sup>6</sup> ±0.01 <sup>b</sup>	5.85±0.02 <sup>b</sup>
0.3	3.27±0.02 <sup>ab</sup>	0.99±0.02 <sup>ab</sup>	6.79 x 10 <sup>6</sup> ±0.01 <sup>ab</sup>	6.33±0.03 <sup>ab</sup>
<b>0.4</b>	<b>3.25±0.01<sup>b</sup></b>	<b>1.02±0.01<sup>a</sup></b>	<b>7.02 x 10<sup>6</sup>±0.03<sup>a</sup></b>	<b>6.49±0.01<sup>a</sup></b>
0.5	3.25±0.01 <sup>b</sup>	1.02±0.03 <sup>a</sup>	7.02 x 10 <sup>6</sup> ±0.01 <sup>a</sup>	5.91±0.03 <sup>ab</sup>

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%)

### Effect of Sugar Concentration in Fermentation to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Chinese jiaotou bulbs were fermented with different salt concentration (2%, 4%, 6%, 8%). Effectiveness of salt concentration in chinese

jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score. Results were depicted in table 4. It's clearly noticed that 6% sugar was optimal for chinese jiaotou fermentation. So we selected this value for next experiments.

**Table 4: Sugar concentration (%) to physicochemical, microbial and sensory characteristics of pickled chinese jiaotou**

Sugar concentration (%)	pH	Total acidity (%)	Lactic acid bacteria (cfu/ml)	Sensory score
2	3.25±0.01 <sup>ab</sup>	1.02±0.01 <sup>b</sup>	7.02 x 10 <sup>6</sup> ±0.03 <sup>b</sup>	6.49±0.01 <sup>b</sup>
4	3.23±0.02 <sup>ab</sup>	1.05±0.02 <sup>ab</sup>	7.33 x 10 <sup>6</sup> ±0.01 <sup>ab</sup>	7.12±0.02 <sup>ab</sup>
<b>6</b>	<b>3.20±0.01<sup>b</sup></b>	<b>1.09±0.01<sup>a</sup></b>	<b>7.47 x 10<sup>6</sup>±0.02<sup>a</sup></b>	<b>7.44±0.01<sup>a</sup></b>
8	3.26±0.01 <sup>a</sup>	1.03±0.00 <sup>ab</sup>	6.33 x 10 <sup>6</sup> ±0.01 <sup>c</sup>	7.14±0.03 <sup>ab</sup>

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%)

### Effect Fermentation Time to Physicochemical, Microbial and Sensory Characteristics of Pickled Chinese Jiaotou

Naturally occurred lactic acid bacteria from the raw ingredients play an important role in fermentation of pickled chinese jiaotou [13]. Chinese jiaotou were fermented with

different fermentation time (7, 14, 21, 28 days). Effectiveness of fermentation time in chinese jiaotou fermentation was based on value of pH, total acidity (%), lactic acid bacteria (cfu/ml), sensory score. Results were depicted in table 5. It's clearly noticed that 21 days of fermentation was optimal for chinese jiaotou fermentation. So we selected this value for application.

**Table 5: Fermentation time (days) to physicochemical, microbial and sensory characteristics of pickled chinese jiaotou**

Fermentation time (days)	pH	Total acidity (%)	Lactic acid bacteria (cfu/ml)	Sensory score
7	3.20±0.01 <sup>ab</sup>	1.09±0.01 <sup>b</sup>	7.47 x 10 <sup>6</sup> ±0.02 <sup>b</sup>	7.44±0.01 <sup>ab</sup>
14	3.19±0.01 <sup>ab</sup>	1.11±0.01 <sup>ab</sup>	7.54 x 10 <sup>6</sup> ±0.01 <sup>ab</sup>	7.69±0.02 <sup>ab</sup>
<b>21</b>	<b>3.18±0.02<sup>b</sup></b>	<b>1.14±0.02<sup>a</sup></b>	<b>8.11 x 10<sup>6</sup>±0.01<sup>a</sup></b>	<b>8.15±0.03<sup>a</sup></b>
28	3.23±0.01 <sup>a</sup>	1.10±0.01 <sup>ab</sup>	7.50 x 10 <sup>6</sup> ±0.01 <sup>ab</sup>	7.21±0.00 <sup>c</sup>

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%)

Fermentation of *Allium chinense* bulbs was carried out with *Lactobacillus plantarum*. A decrease in pH from 6.8 to 3.5 and a stable lactic acid bacteria population were observed during 7-d fermentation. The total phenolic content increased by 2.7-fold in the aqueous

and ethanol extracts of *A. chinense* bulbs after fermentation [6].

### Conclusion

Chinese jiaotou (*Allium chinense*) is a vegetable with good nutritional attributes

but has short shelf-life under the prevailing weather conditions in tropical countries. Chinese jiaotou with their high composition of fermentable reducing sugars such as glucose, sucrose and fructose could serve as substrates for lactic fermentation thus transforming a perishable products to more stable and value added product. Pickled

chinese jiaotou is one of the most consumed fermented vegetable in Vietnam. Fermentation of *A. chinense* bulbs could improve their biofunctionalities, and nutritional and chemical properties. Therefore, production of pickle from this vegetable can help increase added values and reduce post-harvest losses.

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