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RESEARCH ARTICLE

Fermented Juice Production from Persimmon (*Diospyros kaki*) Fruit

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Abstract

Persimmon (*Diospyros kaki*) reveals beneficial health effects owing to nutritional components and antioxidant capacity. It is a good source of fiber, phenolics, minerals, vitamins and other bioactive compounds. However it's sensitive to deterioration in a short harvest season. In this study, fermentation of persimmon juice with probiotic bacteria *Lactobacillus acidophilus* as well as effectiveness of several technical variables in pretreatment and fermentation were investigated. Our results revealed that thermal treatment 65^{0}C in 4 minutes and then cooling at 4^{0}C in 20 minutes were appropriate for tannin reduction to mild astringent taste. The initial inoculations (108 cfu/ml) of Lactobacillus acidophilus, 8% sugar, pH 4.4, temperature 37oC were suitable for persimmon extract fermentation within 24 hours. Persimmon juice fermented probiotic *Lactobacillus acidophilus* was highly value for human health.

Keywords: *Persimmon, Lactobacillus acidophilus, Fermentation, Probiotic, Tannin, Thermal.*

Introduction

Persimmon (*Diospyros kaki* L.) is one of the most important horticultural crops in Vietnam. Persimmon is relatively high content of different nutrients and phytochemicals such as dietary fibers, total and major phenolics, main minerals and trace elements [1, 2]. It's harvested at mature stage to ripen for commercialization and distribution. It is mainly eaten fresh, frozen, canned, dried, juicy [3, 5]. Probiotics are live microorganisms that confer a beneficial heath effect on the host if administered in appropriate amounts. Fruit and vegetable juices have been reported as a novel suitable carrier medium for probiotic [6]. Lactobacillus and Bifidobacterium have become the most commonly used probiotic strains in these food products [7, 8].

The probiotic can benefit human health by balancing the intestinal microorganisms, reducing the intestinal infection incidence, and enhancing the human immunity system. Moreover, it can physically bind to cancerogenic compounds to reduce the toxicity of the compounds [9, 12]. It can significantly change and enhance the organoleptic attributes of products derived from fruits and vegetables [13].

Pupose of our study focused on the thermal treatment for tannin removal as well as several variables affecting to lactic fermentation by *Lactobacillus acidophilus* using the persimmon juice as substrate.

Material and Method

Material

Persimmon fruits were obtained from Lam Dong province, Vietnam. After collecting, they must be quickly conveyed to laboratory for experiments. Chemical substances and reagents such as *Lactobacillus acidophilus,* MRS, Petrifilm-3M were supplied from Rainbow Trading Co. Ltd., Vietnam.

Researching Procedure

Persimmon pulp was utilized to get the extract. Tannin was eliminated by heating the persimmon extract at different conditions (55^{0}C in 8 minutes, 60^{0}C in 6 minutes, 65^{0}C in 4 minutes, 70^{0}C in 2 minutes) then cooling at 4^{0}C in 20 minutes to condense tannin. Filtrate was then pasteurized at 90^{0}C in 3 minutes and then cooled down to 37^{o}C ready for lactic fermentation. Tannin reduction (%) and sensory score were major indicators to determine the effectiveness of astringen

removal. *Lactobacillus acidophilus* was activated in advance by MRS broth at 30°C for 24 hours. During lactic fermentation, *Lactobacillus acidophilus* was added to persimmon filtrate at living cell density 10^8 cfu/ml. This culture was used to further fermentation. Different technical parameters possibly affecting to lactic fermentation such as sugar supplementation (2%, 4%, 6%, 8%, 10%), pH (4.0, 4.2, 4.4, 4.6, 4.8), temperature (33°C, 35°C, 37°C, 39°C, 41°C) were examined thoroughly. Fermentation was executed in 48 hours with above parameters. Total acidity (g/l), living cell (cfu/ml) and sensory score were measured to define the optimal fermentation value.

Chemical, Biological, Sensory and Statistical Analysis

Tannin (%) was quantified by Folin-Denis spectrophotometric method [14]. Total acidity (g/l) was measured by potentiometry method [15]. Living cell of *Lactobacillus acidophilus* was counted in Petrifilm-3M. Sensory score was evaluated by a group of panelists using 9 points-Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Thermal Treatment to Tannin Removal

The astringent felling from persimmon fruit due to the presence of soluble tannins. During postharvest ripening, soluble tannins polymerize and become insoluble [16].Tannin was eliminated by heating the persimmon extract at different conditions (50°C in 10 minutes, 55°C in 8 minutes, 60°C in 6 minutes, 65°C in 4 minutes, 70°C in 2 minutes) then cooling at 4°C in 20 minutes to condense tannin.

Filtrate was then pasteurized at 90°C in 3 minutes and then cooled down to 37°C ready for lactic fermentation. Our results revealed that heating 65°C in 4 minutes and then cooling at 4°C in 20 minutes were appropriate for tannin removal. Similarly in another report, fruit juice from cashew apple as a substrate for the growth of *Lactobacillus acidophilus*. A large amount of tannin out of cashew apple juice was eliminated by heating at 60°C in 5 minutes and cooling 5°C in 20 minutes [17].

Table 1: Effect of thermal treatment to tannin removal (%)

Parameter	Thermal treatment				
	50°C, 10 min	55°C, 8 min	60°C, 6 min	65°C, 4 min	70°C, 2 min
Tannin reduction (%)	26.85±0.01^{c}	28.79±0.03^{bc}	31.26±0.00^{b}	34.52±0.03^{a}	32.77±0.01^{ab}
Sensory score	4.23±0.00^{c}	4.85±0.02^{bc}	5.14±0.01^{b}	5.87±0.02^{a}	5.42±0.00^{ab}

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%)

Lactic Fermentation

Total soluble solid, pH initial and temperature had significantly affected to the growth and stability of bacteria. In case there was too much sugar, bacteria would be inhibited. In contrast, there was too little sugar, acid lactic formation would be low, sugar residue would also be scare and affected to product quality. *L. acidophilus* had an optimum temperature and pH appropriate for growing [17]. Carbohydrates in the juice contribute the major energy sources for the replication and proliferation of lactic acid bacteria [18], meanwhile the pH of a juice plays a key role in the metabolism of bacteria [19]. In our research, different technical parameters possibly affecting to lactic fermentation such as sugar supplementation (2%, 4%, 6%, 8%, 10%), pH (4.0, 4.2, 4.4, 4.6, 4.8), temperature (33°C, 35°C, 37°C, 39°C, 41°C) were examined thoroughly. Our findings revealed that 8% sugar, pH 4.4, temperature 37°C were suitable for persimmon extract fermentation (see table 2-4). Similarly in another report, cashew apple juices were fermented by saccharose 11%, pH 4.0-4.5, temperature 370C [17].

Table 2: Effect of sugar supplementation (%) to lactic fermentation

Parameter	Sugar addition (%)				
	2	4	6	8	10
Total acidity (g/l)	0.65±0.01^{c}	0.84±0.02^{bc}	0.98±0.01^{b}	1.23±0.00^{a}	1.07±0.01^{ab}
Living cells (10^8 cfu/ml)	2.29±0.00^{c}	4.13±0.01^{bc}	5.77±0.02^{b}	8.95±0.01^{a}	6.41±0.00^{ab}
Sensory score	6.03±0.02^{c}	6.74±0.03^{bc}	7.25±0.00^{b}	7.98±0.02^{a}	7.63±0.02^{ab}

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 initial pH to lactic fermentation

Parameter	pH				
	4.0	4.2	4.4	4.6	4.8
Total acidity (g/l)	1.23±0.00^{c}	1.35±0.03^{b}	1.47±0.02^{a}	1.39±0.03^{ab}	1.28±0.00^{bc}
Living cells (10^8 cfu/ml)	8.95±0.01^{c}	9.14±0.00^{b}	9.48±0.00^{a}	9.37±0.00^{ab}	9.05±0.01^{bc}
Sensory score	7.98±0.02^{c}	8.26±0.01^{b}	8.61±0.03^{a}	8.42±0.00^{ab}	8.11±0.03^{bc}

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 fermentation temperature (°C) to lactic fermentation

Parameter	Temperature (°C)				
	33	35	37	39	41
Total acidity (g/l)	1.47±0.02^{c}	1.53±0.02^{b}	1.62±0.00^{a}	1.57±0.01^{ab}	1.50±0.03^{bc}
Living cells (10^8 cfu/ml)	9.48±0.00^{c}	9.69±0.01^{b}	9.85±0.03^{a}	9.78±0.02^{ab}	9.54±0.00^{bc}
Sensory score	8.61±0.03^{c}	8.74±0.00^{b}	8.91±0.01^{a}	8.85±0.01^{ab}	8.66±0.00^{bc}

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%)

Conclusion

The inoculation of lactic acid bacteria represents an easy approach to accelerate the daily consumption of fruit juice. Beneficial effects of probiotic bacteria in fruit include reduction in the level of serum cholesterol, improvement in lactose metabolism, enhanced immune system, lower risk of colon cancer, control of gastrointestinal infections, improved anti-mutagenic properties, and stimulation of anti-diarrheal properties. We have successfully found out some major technical parameters in thermal pretreatment and lactic fermentation for the production of fermented persimmon beverage. From this investigation, the added value of persimmon fruit will be enhanced. People have more chance to utilize this healthy food drink.

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