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RESEARCH ARTICLE

Effectiveness of *Lactobacillus acidophilus* as Probiotic in Cantaloupe (*Cucumis Melo*) Juice Fermentation

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Abstract

Cantaloupe is one of the most consumed fruit crops worldwide specially in Viet Nam due to its pleasant flavour and nutritional value. Cantaloupe is highly perishable, due to its high moisture content. Lots of cantaloupes rot away in the farmland. The production of freshly cantaloupe juice is a best way to raise the merchandise rate of cantaloupe and to prolong its product shelf-life during consumption. Lactic acid fermentation increases the shelf life of cantaloupe juice and also enhances various beneficial properties, including nutritive value and flavours. Objective of this study focused on the effect of *Lactobacillus acidophilus* as probiotic in cantaloup (*Cucumis Melo*) juice production. Different technical parameters such as the initial soluble solid content (8.0, 8.5, 9.0, 9.5, 10.0 ^{o}Brix), *Lactobacillus acidophilus* innoculum size (1.0, 1.5, 2.0, 2.5, 3.0 g/L), fructo-oligosaccharide (0.5%, 1.0%, 1.5%, 2.0%, 2.5%) were examined during fermentation at 37^{o}C in 48 hours. Results showed that the best fermented juice quality would be achieved by the initial soluble solid content 9.5^{o}Brix, *Lactobacillus acidophilus* innoculum size 2.0 g/L, fructo-oligosaccharide 2.0%.

Keywords: *Cantaloup, Lactobacillus acidophilus, Probiotic, Juice, Fructo-oligosaccharide, Innoculum.*

Introduction

Cantaloupe (*Cucumis melo* L.) is a creeping-stem herbaceous plant, whose fruit can have an oval, elliptical, or round shape [1]. It is produced in many regions in the world owing its ability to adapt to different soils and climate [2]. It's one of the most important fruiting vegetables that consumed all over the world [3]. It is a climacteric fruit and its texture, flavor and sweetness effect its quality [4].

The quality of the cantaloupe fruits are characterized by different factors such as the soluble solids content, external and internal appearance of fruit, the thickness of the pulp and its aroma and flavor. The initial quality of the cantaloupe, based on physical appearance such as the size, net development, background colour, and being free from defects [5].The seeds are a good source of flavonoids, phenolics, saponins, alkaloids and other secondary metabolites which are considered to be health beneficial [6, 7]. Cantaloupe is an excellent source of vitamin A, vitamin C, and microelements such as potassium and magnesium [8, 11]. It has been shown medicinal properties such as analgesic, anti-inflammatory, antioxidant, antiulcer, anticancer, antimicrobial, diuretic, a hepato-protective, immune-modulator and antidiabetic properties [12, 13].

Cantaloupe extracts can be considered as new sources of natural antioxidants for food and nutraceutical products. These extracts could be used as preservative ingredients in the food industries [14]. Quality changes of fresh cut cantaloupe in different types of polypropylene packaging were examined [15]. The therapeutic effects of cantaloupe are of great interest for the development of functional foods such as yogurt [16]. Cantaloupe fruit was processed into clarified juice and juice concentrate [17]. One study

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investigated the change of the flavor, enzyme activities and microorganism survival in cantaloupe (*Cucumis melo* L.) juice after UHP treatments [18]. Muskmelon was evaluated for fermentative preparation of an alcoholic beverage [19]. Quality assessment of cantaloupe melon juice under ozone processing was mentioned [20]. 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 [21]. The most commonly employed probiotics includes different strains from Lactobacillus acidophilus and Bifidobacterium [22].

Beneficial effects of probiotic bacteria in food 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 antimutagenic properties, and stimulation of anti-diarrheal properties [23, 24]. Probiotic bacteria need protection from the acidic conditions [25].

The loss of probiotic viability during gastrointestinal transit is considered as a hurdle that probiotics must overcome to fulfill their biological role [26]. Maintaining the viability and activity of probiotics in food products at the end of shelf-life are two important criteria to be fulfilled in fruit juices [27].

Microencapsulation provides a favourable anaerobic environment for sensitive probiotic bacteria and provides a physical hindrance from the harsh acidic conditions of the fruit juice [28]. There was not any research mentioned to the application of *Lactobacillus acidophilus* as probiotic in cantaloup (*Cucumis Melo*) juice production. Therefore, objective of this study focused on the effectiveness of some technical parameters affecting to the juice fermentation such as initial soluble solid content, *Lactobacillus acidophilus* innoculum size fructo-oligosaccharide as prebiotic.

Materials and Method

Material

Cantaloup fruits were collected from Hau Giang province, Vietnam. After collecting, they must be conveyed to laboratory within 8 hours for experiments. They were washed under tap water to remove foreign matters. They were separated skin and seed to collect pulp ready for juice extraction. Distilled water was added for juice preparation. Sucrose was added in different levels to achieve the right total soluble solid.

Lactobacillus acidophilus were cultivated on MRS broth at 37˚C until the late exponential phase of growth was reached. Erlenmeyer flasks containing 100 mL of pasteurized juice were then inoculated the culture. After fermentation, cantaloupe juice was kept in the refrigerator (4°C) for preservation in 3 months. Besides cantaloup fruit we also used another material during the research such as *Lactobacillus acidophilus*, sucrose, Folin-Ciocalteau reagent, sodium carbonate, gallic acid, methanol, $AlCl_3$, MRS broth. Lab equipments include refractometer, UV-VIS Spectrophotometer.

Researching Procedure

Effect of Soluble Solid in Juice for Fermentation

Different soluble solid contents (8.0, 8.5, 9.0, 9.5 and 10°Brix) affecting to juice fermentation were examined. *Lactobacillus acidophilus* was added at 1.0g/L. The fermentation was conducted at 37°C in 48 hours. The final product was analyzed the titratable acidity (g/L), total phenolic (mg GAE/g extract), total flavonoid (µg RE/g extract), DPPH radical-scavenging activity (%) and sensory score.

Effect of Lactobacillus Acidophilus Inoculums Ratio for Fermentation

The fermentation was prepared with soluble solid content 9.5°Brix by the addition of *Lactobacillus acidophilus* in different ratio (1.0, 1.5, 2.0, 2.5, 3.0 g/L) within 48 hours at 37°C. At the end of fermentation, the final product was analyzed the titratable acidity (g/L), total phenolic (mg GAE/g extract), total flavonoid (µg RE/g extract), DPPH radical-scavenging activity (%) and sensory score.

Effect of Fructo-oligosaccharide Supplementation as Prebiotic

The fermentation was prepared with soluble solid content 9.5°Brix by the addition of *Lactobacillus acidophilus* in ratio 2.0 g/L within 48 hours at 37°C. Fructo-oligosaccharide was added as a prebiotic to

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the cantaloupe juice at different concentration of 0.5%, 1.0%, 1.5%, 2.0%, 2.5% at the beginning of fermentation. At the end of fermentation, the final product was analyzed the titratable acidity (g/L), total phenolic (mg GAE/g extract), total flavonoid (µg RE/g extract), DPPH radical-scavenging activity (%) and sensory score

Physico-chemical, Sensory and Statistical Analysis

Total soluble solid (oBrix) was examined by refractometer. Titratable acidity (g/L) content in juice was analyzed by tritration. Total phenolic content (mg GAE/g extract) was determined using Folin-Ciocalteu assay [29]. Total flavonoid content (µg RE/g extract) was determined by the aluminium calorimetric method [30]. DPPH radical-scavenging activity (%) was estimated according to the procedure described by Yi et al [31]. Sensory score was evaluated by a group of panelist using 9 point-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

Effect of Soluble Solid Content in Juice for Fermentation

In our present study, different soluble solid contents (8.0, 8.5, 9.0, 9.5 and 10°Brix) affecting to juice fermentation were examined. Our results were noted in Table 1. The optimal initial soluble solid content was recorded at 9.5°Brix.

Table 1: Effect of soluble solid content (°Brix) in juice for fermentation

Soluble solid content (°Brix)	8.0	8.5	9.0	9.5	10
Titratable acidity (g/L)	0.42±0.01^{c}	0.43±0.00^{bc}	0.45±0.02^{b}	0.48±0.01^{a}	0.46±0.00^{ab}
. Total phenolic (mg GAE/g)	7.01±0.03^{d}	7.25±0.04^{c}	7.38±0.02^{bc}	7.42±0.00^{a}	7.39±0.04^{b}
Total flavonoid (µg RE/g)	5.31±0.02^{c}	5.44±0.01^{bc}	5.59±0.01^{b}	5.62±0.02^{a}	5.60±0.01^{ab}
DPPH (%)	63.07±0.04^{c}	63.71±0.02^{bc}	64.74±0.03^{b}	65.12±0.04^{a}	64.88±0.00^{ab}
Sensory score	5.21±0.00^{c}	5.46±0.03^{bc}	5.74±0.00^{b}	6.15±0.01^{a}	5.90±0.02^{b}

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%)

Juice pressed from cantaloupe flesh without rind was particularly difficult to filter, filtration being easier if the flesh had been frozen and thawed [17].Star fruit juice fermented by *Lactobacillus helveticus, Lactobacillus paracasei* and *Lactobacillus rhamnosus* with the initial total soluble solids content 7.09 °Brix. The star fruit juice fermented by *L. rhamnosus* produced the highest amount of lactic acid, resulting in a significant lower pH (4.41) than that of *L. helveticus* (4.76) and *L. paracasei* (4.71) [32].

Effect of *Lactobacillus acidophilus* Inoculum Ratio for Fermentation

In our present study, different *Lactobacillus acidophilus* inoculum ratios (1.0, 1.5, 2.0, 2.5, 3.0 g/L) for fermentation were examined. Our results were noted in Table 2. The optimal *Lactobacillus acidophilus* inoculum ratio was recorded at 2.0 g/L.

Table 2: Effect of *Lactobacillus acidophilus* inoculum ratio for fermentation

Inoculum ratio (g/L)	1.0	1.5	2.0	2.5	3.0
Titratable acidity (g/L)	0.48±0.01^{b}	0.49±0.02^{ab}	0.50±0.04^{a}	0.50±0.03^{a}	0.50±0.01^{a}
. Total phenolic (mg GAE/g)	7.42±0.00^{b}	7.52±0.02^{ab}	7.84±0.01^{a}	7.85±0.02^{a}	7.85±0.02^{a}
Total flavonoid (µg RE/g)	5.62±0.02^{b}	5.79±0.03^{ab}	5.97±0.00^{a}	5.97±0.00^{a}	5.98±0.00^{a}
DPPH (%)	65.12±0.04^{c}	66.48±0.00^{b}	67.42±0.02^{a}	67.45±0.01^{a}	67.46±0.01^{a}
Sensory score	6.15±0.01^{b}	6.78±0.01^{ab}	7.24±0.01^{a}	7.24±0.03^{a}	7.24±0.03^{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%)

In another report, n order to obtain the optimum inoculum size of goat milk fermented by probiotics, the total inoculum size containing L. acidophilus or L. casei on pH, acidity and viable counts and sensory during fermentation were studied on the basis of S. thermophilus and L. bulgaricus as starter cultures.

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The results showed as follows: the optimum inoculum size of L. acidophilus and L. casei were all 7% and goat milk was fermented at 39°C for 4.5h [33].

Effect of Fructo-oligosaccharide Supplementation as Prebiotic

In our present study, different concentrations of fructo-oligosaccharide (0.5%, 1.0%, 1.5%, 2.0%, 2.5%) were examined. Our results were noted in Table 3.The optimal fructo-oligosaccharide supplemented at 2.0%.

Table 3: Effect of fructo-oligosaccharide supplementation as prebiotic

Fructo-oligosaccharide (%)	0	0.5	1.0	1.5	2.0	2.5
Titratable acidity (g/L)	0.50±0.04^{c}	0.52±0.04^{bc}	0.54±0.03^{b}	0.57±0.02^{ab}	0.60±0.01^{a}	0.60±0.03^{a}
Total phenolic (mg GAE/g)	7.84±0.01^{c}	7.94±0.03^{bc}	8.12±0.00^{bc}	8.39±0.00^{b}	8.55±0.00^{a}	8.57±0.00^{a}
Total flavonoid (µg RE/g)	5.97±0.00^{d}	6.49±0.01^{c}	6.95±0.02^{bc}	7.28±0.04^{b}	7.74±0.02^{a}	7.76±0.01^{a}
DPPH (%)	67.42±0.02^{c}	67.64±0.02^{bc}	67.79±0.01^{bc}	67.92±0.01^{b}	68.09±0.00^{a}	68.11±0.02^{a}
Sensory score	7.24±0.01^{c}	7.38±0.00^{bc}	7.85±0.03^{bc}	8.04±0.03^{b}	8.26±0.04^{a}	8.30±0.01^{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%)

In one study, fermentation of pineapple juice with probiotic bacteria Lactobacillus and Bifidobacterium strains as well as changes of some properties in the beverage during storage were investigated. Supplementation with prebiotics at the initiation of fermentation resulted 7 mM lactic acid and 23 mM acetic acid at the end of fermentation [26].

Conclusion

Cantaloupe belongs to the Cucurbitaceae family. It's popular due to the refreshing pulp of the fruit and high nutrition content and it is well recognized for culinary and medicinal purposes. It's rich in molecules like polyphenols, carotenoids, and other biologically active components that possess a positive influence on human health and wellness. Cantaloupe is a favorable fruit with unique aroma. Fermented products as a component of a daily diet, may improve the health and life quality of consumers. Consumers tend to prefer the food and beverages that are fresh, highly nutritional, health promoting and ready to consume.

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