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Different factors affecting to custard apple *Annona squamosal* wine fermentation

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Abstract
Custard apple (*Annona squamosa* L.) is one of the important fruit crop growing on Mekong river delta. The fruits are soft granular, juicy with mild flavour. It is one of the delicious and nutritionally valuable fruit. Fruit is consumed as fresh, ice cream, custard apple powder and beverages etc. The fruits are rich in sugar, proteins and minerals. The custard apple is almost entirely consumed as a dessert fruit. In this research, we investigate the fermentation process to produce custard apple wine. We examine two different extraction methods: grinding and osmosis. I realize that grinding is three times better than omosis. Yeast species is *Saccharomyces cerevisiae* with 10% supplementation to get yeast cell density $5x10^6$ CFU/ml; initial soluble dry matter 20%, the main fermentation in 4 days, ethanol formation in wine 8.2 degree, soluble dry matter in wine 7.25^{o}Brix.

Keywords: *Custard apple, wine, fermentation, Saccharomyces cerevisiae*

1. Introduction
The custard apple (*Annona squamosal* L.) is one of the important dry land fruit grown in arid land throughout the country. The pulp has a pleasant texture and flavour. It is sweetwith moderate acidity (Umesh Balkrishna Jagtap and Vishwas Anant Bapat, 2012; Virendra Singh *et al.*, 2013; T. Sravanthi *et al.*, 2014). In accordance with the sweet taste of the fruit pulp the amounts of sugars were found to be quite high (58% of dry mass). The triglyceride concentration was found to be very low. The presence of the diterpenoid compound kaur-16-en-18-oic acid in a considerable amount (0.25% of dry mass) was detected in the lipid fraction. The major compounds were α -pinene (25.3%), sabinene (22.7%) and limonene (10.1%) (Eloisa Helena A. Andrade *et al.*, 2002).
Custard apple is considered as one of the delicious and nutritionally valuable fruit meant for table purpose (Mariappan *et al.*, 1983). Fruits have an edible, soft, granular, juicy and sugary pulp with mild flavor and with slight acidity (Butani *et al.*, 1978). Fruits are considered for their medicinal value besides their general use in ice cream, confectionery, beverage and certain milk products (K. J. Kamble and S. B. Soni, 2010; Virendra Singh *et al.*, 2013). Custard apple is considered as one of the delicious and nutritionally valuable fruit. It contains about 28-55% of edible portion consisting of 73.30% moisture, 1.60% protein, 0.30% fat, 0.70% mineral matter, 23.90% carbohydrates, 0.20% calcium, 0.40% phosphorus, 1.0% iron, 12.4-18.15% sugar, 0.26-0.65% acidity and with caloric value. Custard apple is generally classified as semi wild fruit by virtue of its spontaneous spread in forests, waste lands and other uncultivated places. Custard apple ripens within four days after harvest. Fruits can safely be ripened in straw and fruit leaves and stored at room temperature with a shelf life of four days (García-Alonso *et al.*, 2004). The ripe fruits being soft require careful handling in marketing (Gamboa *et al.*, 2005). Like many other tropical fruits, the mature custard apple fruits get chilling injury if stored below 15^{o}C, while ripe fruits can be stored at 5oC, for six weeks (Annabelle et al., 2006; T. Sravanthi *et al.*, 2014).
Ninad V Chikhalikar *et al.* (2000) studied on frozen pourable custard apple (*Annona squamosa* L) pulp using cryoprotectants. Kumar Vikas *et al.* (2011) prepared and evaluated custard apple wine: Effect of dilution of pulp on physico-chemical and sensory quality characteristics. Umesh B. Jagtap and Vishwas A. Bapat (2014) evaluated the potential of custard apple (*Annona squamosa* L.) in the production of a beverage fermented using *Saccharomyces cerevisiae.* Purpose of our research is to examine several factors influencing to custard apple wine fermentation such as extraction method, the initial dry matter, yeast species, yeast ratio for supplementation.

2. Material & Method

2.1 Material

Custard apple is purchased in Mekong river delta, Vietnam. *Saccharomyces cerevisiae* is supplied from Pasteur Institute, Vietnam.

Fig 1: Custard apple

2.2 Research method

2.2.1 Experiment #1: Method of juice extraction

Table 1: Experimental arrangement to verify the method of juice extraction

Extraction method	Grinding	Osmosis
Checking parameter		
Soluble dry matter (%)		
pH		
Ethanol (%/v)		
Extracted juice (ml)		

Fixing parameters include initial dry matter 20%; fermentation time 4 days; yeast species *Saccharomyces cerevisiae*; yeast ratio 10%. Checking parameters include the soluble dry matter, pH, ethanol, extracted juice.

2.2.2 Experiment #2: Yeast species for fermentation

Table 2: Experimental arrangement to verify yeast species for fermentation

Yeast species	*Saccharomyces* sp.	*Saccharomyces cerevisiae*
Checking parameter		
Soluble dry matter (%)		
pH		
Ethanol (%/v)		

Fixing parameters include initial dry matter 20%; fermentation time 4 days; yeast ratio 10%, fermentation temperature 30 ^oC. Checking parameters include the soluble dry matter, pH, ethanol, fermentation capability, CO_2 emission.

2.2.3 Experiment #3: Effect of yeast ratio to fermentation

Table 3: Experimental arrangement to verify yeast ratio to fermentation

Yeast ratio (%)	5	10	15
Checking parameter			
Soluble dry matter (%)			
pH			
Ethanol (%/v)			

Fixing parameters include initial dry matter 20%; fermentation time 4 days; fermentation temperature 30 ^oC. Checking parameters include the soluble dry matter; pH; ethanol; fermentation capability; CO_2 emission.

2.2.4 Experiment #4: Effect of soluble dry matter to fermentation

Table 4: Effect of soluble dry matter to fermentation

Soluble dry matter (%)	15	20	25	30
Checking parameter				
pH				
Ethanol (%/v)				

Fixing parameters include fermentation time 4 days; yeast ratio 10%, fermentation temperature 30 ^oC. Checking parameters include the pH, ethanol, fermentation capability, CO_2 emission.

2.3 Statistical analysis

All data are processed by Excel 2003 and Startgraphic.

3. Result & Discussion

3.1 Chemical composition in custard apple

Table 5: Chemical composition in ripe custard apple

1	Soluble dry matter	17.8
2	pH	3.51
3	Acidity (g/l)	0.55±0.02
4	Reduced sugar	5.36±0.50
5	Total sugar (%)	6.25±0.50

In table 5, we can see the high content of soluble dry matter in custard apple (17.8%) together with total sugar, reduced sugar those are ideal for fermentation.

3.2 Effect of extraction method

Table 6: Effect of extraction method to juice efficiency

Checking parameter		
Soluble dry matter (%)	8.533^a	8.500^a
pH	3.460^a	3.497^a
Ethanol (%/v)	6.307^a	6.327^a
Extracted juice (ml)	381.333^b	139.600^a

Through table 6, we see that grinding is triplicate higher efficiency than osmosis. So we choose grinding method for further experiments.

3.3 Effect of yeast species to fermentation

Table 7: Effect of yeast species to fermentation

Checking parameter		
Soluble dry matter (%)	14.60	9
pH	3.44	3.45
Ethanol (%/v)	2.97	6.05

From table 7, we decide to choose Saccharomyces cerevisiae for custard wine fermentation

3.4 Effect of yeast ratio to fermentation

Table 8: Effect of yeast ratio to the soluble dry matter, ethanol, and pH in wine

Yeast ratio (%)	5	10	15
Checking parameter			
Soluble dry matter (%)	15^{c}	10.40^{b}	6.53^{a}
pH	3.43^{a}	3.45^{a}	3.45^{a}
Ethanol (%/v)	2.75^{a}	5.28^{b}	7.41^{c}

From table 8, yeast ratio 10% is appropriate for wine fermentation.

3.5 Effect of the initial soluble dry matter to wine fermentation

Table 9: Effect of the initial soluble dry matter to wine fermentation

Soluble dry matter of wine	4.13	8.26	14.33	21.33
pH	3.443^{a}	3.442^{a}	3.440^{a}	3.437^{a}
Ethanol (%/v)	5.977^{b}	6.453^{c}	5.867^{b}	4.767^{a}

Before fermentation, the initial soluble dry matter of custard apple juice is 15%, 20%, 25%, 30%. After 4 days of fermentation, the average soluble dry matter in wine is 4.13%; 8.26%; 14.33%; 21.33%. Reductions of soluble dry matters are 10.86%; 11.74%; 10.67%; 8.67%. This is the sugar consumed during fermentation.

4. Conclusion

Custard apple is one of the important fruit crops of Mekong river delta, which ripen within four days after harvest. Considering the fast increasing area under custard apple cultivation, methods of its preservation and processing technology needs to be developed to regulate the prices of produce during glut period.

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