ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Effectiveness of Fining Agents for Wax Apple (*Syzygium samarangense*) Wine Clarification

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Abstract

Waxe apple fruits are rich sources of nutrition with water, carbohydrate, protein, vitamins, and minerals, along with some medicinal properties. This fruit is highly perishable because of its thin skin and can be easily damaged. The processing of wax apple juice into wine could enhance the value of the fruit. However, turbidity in waxe apple wine is a major problem limiting its contribution to international commercialization. Wine clarification is a widely applicable procedure that involves an agent or a mixture being supplemented to clarify, stabilize or modify the sensory wine attributes. Objective of this study focused on the feasibility of different fining agents such as gluten, gelatin, maize zein, casein, bentonite for clarification of waxe apple wine. This research also examined if there was any synergistic effect while combining gluten with gelatin to improve their fining capability. Our results revealed that 5.0:3.0 g/hL (gluten: gelatin) was adequate to control the haze cloud or turbidity after 3rd week racking of waxe apple wine.

Keywords: *Waxe apple, Wine, Fining, Clarification, Turbidity, Gluten, Gelatin.*

Introduction

Wax apple fruit (*Syzygium samarangense*) is a tropical fruit with many nutritional bioactive compounds and high economic value [1]. When fully ripe, the thin-skinned fruit is highly susceptible to physical damage and microbial spoilage that significantly reduce its commercial value [2]. It could be processed by fermentation and conversion into high valued wine in red-pink, clear and transparent appearance. Wax apple wine contains most of the nutrients present in the original fruit juice. The nutritive value of wine is increased due to the release of amino acids and other nutrients from yeast during fermentation [3].

Wine is a food with a flavor like fresh fruit which could be stored and transported under the existing conditions. At high pH, organic protein fining agents may possess a positive charge insufficient to bind to the negatively charged particulates, thus potentially increasing the turbidity of the wine [4].Clarification or fining is the addition of a reactive or adsorptive substance to alter its clarity to create an adsorbent, enzymatic or ionic bond with the suspended particles, making them a larger molecule that can precipitate out of the wine easier and quicker [5]. Normal reason to perform wine clarifying treatments is to remove phenolic substances, and that tannins have a high tendency to bind proteins. The fining agents come from animal or plant protein. Gluten is a mixture of different water-insoluble proteins constituting the storage proteins of the wheat kernel, and comprises the monomeric alcohol-soluble gliadins and the insoluble polymeric glutenins [6]. Gelatin is colloidal in nature and primarily has a positive charge; it attracts tannins which are primarily negatively charged.

In binding to the negatively charged particles the combined weight increases resulting in settling to occur [7]. Maize zein is a group of proteins constituting the prolamins. Zeins have several attractive characteristics for their utilization in wine fining. Casein is extracted from milk. It is one of the most commonly used processing aids for the clarification of both white and red wines. Bentonite, which carries a net negative charge, interact electrostatic ally with the positively charged wine proteins, which results in their removal from the wine [8]. Objective of this our study penetrated on the capability of different fining agents such as

gluten, gelatin, maize zein, casein, bentonite for clarification of waxe apple wine.

Materials and Method

Material

Plump fruits were collected from Can Tho city, Vietnam. After collecting, they were subjected to wine fermentation. The wine was racked 3 weeks after alcoholic fermentation in stainless steel (temperature controlled at 18±2^{o}C). Fining tests were carried out in plastic graduated cylinders (volum 500 mL and internal diameter 52 mm) filled to 250 mL with wine. Fining agents (gluten, gelatin, maize zein, casein, bentonite) were added into wine at different dose to demonstrate the effectiveness of clarification.

Researching Procedure

Clarification of Wine by Variety of Fining Agents

Different fining agent (gluten, gelatin, maize zein**,** casein, bentonite) were added into wine at the same dose 2.0 g/hL. Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (Nephelos turbidity units or NTU) were measured 24 hours after the addition of fining agents by turbidimeter.

Clarification of Wine by Dose of Fining Agent

Different gluten doses (2.0, 4.0, 6.0, 8.0, 10.0 g/hL) were added into wine.

Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (Nephelos turbidity units or NTU) were measured 24 hours after the addition of fining agents by turbidimeter.

Synergistic Effect of Combined Fining Agents in Clarification of Wine

The synergistic effect of combined fining agents in clarification of wine was demonstrated in variety of formulas of gluten: gelatin (2.0:6.0, 3.0:5.0, 4.0:4.0, 5.0:3.0, 6. 0: 2.0 g/hL). Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (Nephelos turbidity units or NTU) were measured 24 hours after the addition of fining agents by turbidimeter.

Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Wine Clarification by Variety of Fining Agents

Different fining agent (gluten, gelatin, casein, bentonite) were added into wine at the same dose 2.0 g/hL. Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (NTU) were measured 24 hours after the addition of fining agents by turbidimeter. Our result showed that gluten was noticed as the one of best fining agents for wine clarification (see Table 1).

Table 1: Effect of fining agents for wine clarification

Fining agent	Gluten	Gelatin	Maize zein	Casein	Bentonite
Turbidity (NTU)	1.58±0.01^{c}	1.89±0.03^{bc}	2.87±0.02^{a}	2.45±0.00^{ab}	2.27±0.03^{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%)

Wheat gluten protein preparations were effective fining agents for red wines [9]. Fining the red wines with gluten had a small impact on proanthocyanidins. Gluten did not remove color and removed significantly less volatiles than gelatin from the wines [10]. A study compared gluten to casein, gelatin-tannin association, fish glue, and bentonite. Gluten could clarify the wine only at high addition rates (20 to 40 g/hL), while fish glue and casein were much more effective at low addition rates [11]. Gluten showed similar clarification ability to that of casein, PVPP and bentonite, while it produced a lower amount of lees [12]. Fining with zeins did not significantly affect the wine color, nor did it negatively modify the sensorial properties when compared with the gelatin-fined wines [13]. The effectiveness of gelatin and kaolin in clarifying wine was compared. Gelatin was a better clarifier than kaolin [5]. Bentonite alone has a low effect on the loss of terpenes but removed ethyl esters and fatty acids. The presence of wine proteins in the solution

treated with bentonite tended to increase the loss of esters with the longest carbon chains. Hydrophobicity can be one of the driving forces involved in the interaction of aromas with both bentonite and proteins [8].

Wine Clarification by Dose of Fining Agent

Different gluten doses (2.0, 4.0, 6.0, 8.0, 10.0 g/hL) were added into wine. Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (NTU) were measured 24 hours after the addition of fining agents by turbidimeter. Our result showed that 8.0 g/hL of gluten was adequate for fining of wine (see Table 2).

Table 2: Wine clarification by dose of gluten as fining agent

Gluten dose (g/hL)	2.0	4.0	6.0	8.0	10.0
Turbidity (NTU)	1.58±0.01^{a}	1.32±0.00^{ab}	1.23±0.01^{ab}	1.07±0.03^{b}	1.05±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%)

Gluten used as fining agent had less impact on the color and anthocyanin content of red wines, while the traditional animal based fining agents impacted more significantly the wine phenolic composition [14].

Synergistic Effect of Combined Fining Agents in Wine Clarification

The synergistic effect of combined fining agents in clarification of wine was demonstrated in variety of formulas of gluten: gelatin (2.0:6.0, 3.0:5.0, 4.0:4.0, 5.0:3.0, 6.0: 2.0 g/hL). Graduated cylinders were rotated twice to homogenize fining agents and wine. Turbidities (NTU) were measured 24 hours after the addition of fining agents by turbidimeter. Our result showed that at formula of gluten: gelatin (5.0:3.0, g/hL) was appropriate for fining of wine (see Table 3).

Table 3: Synergistic effect of combined gluten: gelatin as fining agents in wine clarification

Gluten: gelatin (g/hL)	2.0:6.0	3.0:5.0	4.0:4.0	5.0:3.0	6.0:2.0
Turbidity (NTU)	1.04±0.00^{a}	0.98±0.02^{ab}	0.93±0.00^{ab}	0.86±0.01^{b}	0.85±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%)

Gluten and gelatin were similar in reducing turbidity, but gluten had the advantage of producing fewer lees and reduced the content of polyphenolic material less than gelatin did [15]. The wines treated with glutens had residual wine post-filtration turbidity that was lower than that achieved using gelatin [16]. Some of the gluten preparations were reported to remove highly galloylated tannins in similar quantities as gelatin, while gelatin was more effective in removing total tannins [17].

Conclusion

Wax apple wine represents potential benefits for human health because they are rich source of polyphenolic antioxidants. Turbidity in wax apple wine is a major problem limiting its contribution to international commercialization. Clarification treatments involve the supplementation of one agent or a mixture to wine in order to clarify, stabilize or modify the wine's sensory attributes. Clarification agents will combine the target elements to create insoluble aggregates that are subsequently removed from the wine. We have successfully found that a combination of gluten and gelatin would create a synergistic effect in haze cloud removal. The use of wax apple for the production of wine will create employment, income generation for farmers.

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