EFFECT OF GELATIN ON APPLE JUICE TURBIDITY

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***Abstract*— Clarification of apple juice by flocculation and precipitation with bentonite and gelatin is explained on a more systematic basis, essentially through the determination of turbidity and zeta-potential. Apple juice was also treated with Polyvinylpolypyrrolidone (PVPP) to remove total polyphenol. Gelatin-particle complex was evaluated as the increase in juice turbidity after the adding of tannic acid. The change of slope during Zeta potential determination indicated that electrostatic forces predominate at low gelatin content, and hydrophobic and hydrophilic interactions occur later at a higher gelatin content. Results also indicated that tannic acid test is useful for determining optimal gelatin concentration for clarification, as test was unaffected by soluble solids, acidity, or pectinase treatment. Gelatin consumption was mainly attributed to colloidal particles. Finally, results indicated that risk of haze by free gelatin in juice required at least 10 times more gelatin than the optimum dosage for clarification.**

***Keywords*— bentonite, gelatin, polyphenol, PVPP, tannic acid, apple juice clarification.**

I. INTRODUCTION

Cloudy apple juice is a colloidal suspension where the continuous medium is a solution of pectin, sugars and malic acid, and the dispersed matter is mainly formed by cellular tissue comminuted during fruit processing. A colloid is a suspension in which the dispersed phase is so small (~1-1000nm) that gravitational forces are negligible and interactions are dominated by short-range forces, such as van der Waals attraction and surface charges. The inertia of the dispersed phase is small enough to exhibits random Brownian motion, driven by momentum imparted by collisions with molecules of the suspending medium.

For obtaining a clear juice these suspended particles have to be removed. This process is known as clarification, or fining, one of the most important unit operations in apple juice processing. To obtain a completely transparent liquid, suspension must be firstly un-stabilized. This procedure helps also to remove active haze precursors, decreasing the potential for haze formation during storage and providing a more limpid juice (Hsu *et al.*, 1987; 1989; 1990). Therefore, the fining step is an important procedure that should be carefully controlled during the processing of clarified apple juice.

Conventional enzyme clarification appears to be a critical processing step which, if excluded, may result in the formation of larger quantities of haze (Tajchakavit, *et al.*, 2001). Enzymatic treatment also allows an efficient use of clarifying agents to assist with cloud removal. Addition of fining, or clarifying, agents is intended to modify clarity, color, flavor and/or stability of juices. They are grouped according to their general nature in (i) Earths (bentonite, kaolin); (ii) Proteins (gelatin, isinglass, casein, albumen); (iii) Polysaccharides (agars); (iv) Carbons; (v) Synthetic polymers (PVPP, nylon); (vi) Silicon dioxide (kieselsols); and (vii) Others, including metal chelators, enzymes, etc. (Zoecklein, 1988).

Clarification of apple juice with gelatin and bentonite is a common industrial practice (Stocké, 1998). These fining agents work either by sticking to the particles, or by using charged ions to cause particles to stick to each other, in any case making them heavy enough to sink to the bottom by the action of gravity. What is left is a transparent though not a clear juice. Subsequent filtration operations are needed to obtain a crystal clear product. Differences in the nature of ionic charges of protein, polyphenols and the fining agents, induce flocculation and sedimentation and result in the removal of these potential haze precursors from solution.

Both tannins and anthocyanins in fruit juices are proposed as the major source of the hydrogen bonds, which are the basis of complex formation between gelatin and tannins or anthocyanins. Haze-active polyphenol may increase consumption of gelatin during fining.

Determination of appropriate doses of clarifying apple juice agents (bentonite, gelatin) is usually made at the industry by trial and error: basically, in a matrix of test tubes filled with enzymatically treated juice, increasing quantities of bentonite and gelatin are added in rows and columns, respectively. The dose that in a shorter time gives the most compact flocks and transparent supernatant is selected for the bulk treatment of juice.

During the last years conventional clarification process is being replaced by the use of ultrafiltration membranes (Alvarez *et al.*, 1998). However clarification of fruit juice by ultrafiltration alone does not remove active haze precursors, allowing haze formation during storage. Bentonite, Polyvinylpolypyrrolidone (PVPP) and activated charcoal are used to eliminate natural polyphenols present in fruit juices (Kwang-Sup *et al.*, 2004). It was also claimed that gelatin, contrarily to PVPP which eliminate all fruit juice polyphenols, would only eliminate post-bottling haze forming polyphenols (Siebert and Lynn, 1997). For that reason gelatin is a frequently used clarifying agent by fruit processing industries at the present.