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Research Note

Effect of addition of Sodium Benzoate on the fermentation behaviour, physico-chemical and sensory qualities of plum wine

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Abstract

Plum being highly perishable crop, needs processing to overcome the postharvest losses and preparation of wine is one of the alternatives. Effect of different concentrations of sodium benzoate (0-400 mg/L) on fermentability, physico-chemical characteristics and sensory quality the plum must was determined. The results showed that in general, the addition of sodium benzoate decreased the fermentation, but a concentration of 100-200 mg/L and the control were statistically at par with each other. Ethanol content decreased proportionately with increase in sodium benzoate concentration in plum must contrary to the TSS of the must and Vit C content which increased. However, titratable acidity and pH remained unaffected. The sensory quality of the plum wine was improved with addition of sodium benzoate. Thus, the addition of 100-200 ppm sodium benzoate to the plum must gave the product with best quality.

Keywords: Sodium benzoate, Plum, Fermentation, Wine, Quality, Ethanol

Plum (Prunus salicina) is grown in several countries of the world including India (Kishor *et al.,* 1991; Bhutani and Joshi, 1995). In India, the stone fruits constitute about 20 percent of the total fruit production of Himachal Pradesh (Joshi *et al.*, 1991). The fruit has an attractive colour, fermentable sugar and appealing flavor but is highly acidic. It is highly perishable fruit with a shelf-life of 3-4 days only at ambient temperature and 1-2 weeks in the cold storage. Plum is used both for dessert and processing purposes such as in preparation of jam, nectar and squash (Woodroof and Luh, 1975; Joshi *et al.*, 1993). A part of the crop is also dried. In India, the production of various fruits and their postharvest losses indicate a wide scope of production of wine from different fruits such as plum. So the fruit can be utilized in preparation of alcoholic beverages including wines and vermouth (Amerine *et al.*, 1980; Vyas and Joshi, 1982 and Joshi *et al.,* 1991). According to Vyas and Joshi (1982) the method of plum wine making includes the preparation of must, addition of water to pulp in 1:1 ratio and with initial TSS of 24°B. Joshi and Bhutani (1990) reported that out of three cultivars of plum, Santa Rosa was found to be the best for wine making. Effect of initial sugar concentration and influence of different yeast cultures on fermentation behaviour, physico-chemical characteristics of plum wine has also been determined (Joshi *et al.,* 2009 (a) & (b)). According to Atkinson et al. (1959), SO_2 provides a clean fermentation and 100 ppm of SO_2

prevented oxidation and controlled undesirable microorganisms whereas in the absence of SO_2, the growth of yeasts other than S. cerevisiae was possible resulting in variation in the composition of the fermented medium (Herraiz *et al.,* 1990). In wine making potassium metabisulphite (KMS) is commonly used to contain the wild micro-flora for efficiently conducting the fermentation (Amerine *et al.*, 1980). Sodium banzoate is added to the coloured products instead of potassium meta-bi-sulphitc (Thakur *et al.,* 2000). It was observed in our earlier studies that addition of sodium benzoate instead of potassium metabisulphite (KMS) improved the colour and sensory qualities of plum wine where the concentration of sodium benzoate used was 300 ppm (Joshi and Bhutani, 1990). However, there is no documentation of effect of different concentrations of sodium benzoate on physico-chemical and sensory quality of plum wine. In this experiment, different levels (0-400 ppm) of sodium benzoate were used in wine preparation in order to optimize its concentration and the results obtained are discussed in this paper.

Material and Method

Collection of fruits

Plum fruits of cv. 'Santa rosa' were procured from Dr YS Parmar University of Horticulture and Forestry, Orchard, Nauni, Solan, HP. The fruits were harvested at proper maturity. The yeast, Saccharomyces cerevisiae UCD 595 used in the study were procured from Dept. of Enology and Viticulture, UCD California Davis, USA.

Preparation of wine

To prepare wine, the fruits were converted into pulp. Preparation of pulp, must and fermentation, siphoning, etc., were the same as reported earlier (Bhutani and Joshi, 1995). Plum wine was prepared from must with four different treatments, viz. T1 control (no sodium benzoate addition), T2 with 100 ppm; T3 200 ppm and T4 300 ppm and T5 400 mg/L of sodium benzoate. The initial TSS of the must was raised to 24°B using cane sugar syrup. The must of different treatments were inoculated with *Saccharomyces cerevisiae* var *ellipsoideus* at the rate of 5% as per the method described earlier (Vyas and Joshi, 1982). The fermentation was carried out as out-lined earlier except for the addition of sodium benzoate (Joshi, 1997; Amerine *et al.,* 1980).After completion of fermentation, the wine was siphoned/racked, bottled and pasteurized. Wines of different treatments were analyzed for various physico-chemical and sensory quality characteristics.

Physico-chemical analyses

During fermentation, TSS was measured till stabilized using a refractometer. The fall in TSS was used to calculate the rate of fermentation (°B/24 hr) reported in the paper. Various physico-chemical characteristics of the treated wines were analysed as per the standard methods. Total soluble solids (%) were measured using a refractometer, titratable acidity was measured by titration method and pH, was measured as per the AOAC method (AOAC., 1980). The pH was measured using a pH meter, after standardization with buffers of pH 4 and 9.

Ethanol content was determined by spectro-photometric method (Caputi *et.al.,* 1968), using potassium dichromate. The absorbance was taken at 600 nm in a calorimeter. The standard curve was prepared using pure ethanol in concentrations ranging from 0 to 8% and the content of ethanol in the experimental sample was determined and expressed as percent. The volumetric method given by Pilone *et al*. (1972) was used to determine the volatile acidity of the wines and it was expressed as acetic acid (g/100 ml). Vitamin C was determined by method 2,6-Dichlorophenol-Indophenol visual titration method The capacity of a sample to reduce a standard dye solution is directly proportional to the ascorbic acid content. The vitamin C was expressed as ascorbic acid (mg/100g). Colour: Lovinbond Tintometer model E was used to measure the colour of the products using one inch cell. The colour was expressed as red, blue and yellow units as per the standard procedure (Rangana, 1986).

Sensory Evaluation: The sensory evaluation of wines of different treatments was conducted by a semi-trained panel of judges. The panel comprised of 10 judges. Each sample was evaluated for various quality attributes viz. colour and appearance, aroma and bouquet, volatile acidity, total acidity, sweetness, body flavour, bitterness, astringency and overall impression (Amerine *et al.,* 1980; Joshi, 2006). Scores of various characteristics were added and expressed out of maximum 100.

Statistical Analysis: The data of physic-chemical characteristic method were analysed by completely randomized design as per the standard method (Cockrane and Cox, 1963).

Result and Discussion

Comparison of the rate of fermentation of control with other treatments showed a decrease in rate of fermentation with increase in concentration of sodium benzoate (Fig 1). The physico-chemical, characteristics and fermentation behavior of prepared wine, presented in table 1 showed that there was no significant difference in the wine made with 100 ppm and 200 ppm. However, addition of higher concentration of sodium benzoate reduces the rate of fermentation to a very low level. Therefore, from fermentability point of view, addition of 100-200 ppm of NaB could be made without adversely affecting the fermentation. The results show that as the concentration of sodium benzoate was increased the TSS also increased thus, corroborating with the lower rate of fermentation discussed earlier. NaB is known as inhibitor of fermentation by S. cereviace (Thakur *et al.,* 2000) but lower concentration might not have inhibited the fermentation compared to the higher. The refore addition of sodium benzoate might have inhibited the growth of wild micro flora as has been found for potassium metabisulphite (Herraize *et al.,* 1990). The trend in the TSS of the wine was in consistence with the fermentability of the respective musts, as discussed earlier. Since during fermentation, sugar is utilized to produce alcohol (Amerine *et al.,* 1980; Joshi, 1997), a decrease in TSS (a measure of sugar content) has taken place.

There is no significant difference in the pH values of the wines made with different concentration of sodium benzoate nor it is expected (Table 1). There is no report available on the effect of addition of sodium benzoate on the acidity or pH of the wines. However, no appreciable difference between the values of titratable acidity of the wines treated with KMS and sodium benzoate has been documented earlier (Joshi and Bhutani, 1990). Besides, dilution of must with water to produce the wine of lower acidity, potential use of deacidifying yeast *Schizosaccharomyces pombe* in plum must has also been stressed (Vyas and Joshi, 1988; Joshi *et al.,* 1991). The highest alcohol content was obtained in wine made with-out addition of NaB as was the case with the volatile acidity which decreased with increase in the concentration of Na B. Since the fermentability of plum must was reduced, the alcohol contents were also reduced significantly. However, statistically the wines without Na B or 100 ppm Na B were at par with each other. In the literature, there is no report available indicating the effect of sodium benzoate on the alcohol content of wine though the wine made with KMS and sodium benzoate had almost similar alcohol content (Joshi and Bhutani, 1990). The content of vitamine C increased with increase in concentration of Sodium benzoate Table 1 but at 400 ppm the qualtiy of vitamine C decreased in the treated wines. Thus, the addition of increasing sodium benzoate concentration help retained higher concentration of Vitamine C. May possibly be due to prevention of oxidation by addition of sodium benzoate or KMS as both are known to prevent the oxidation process. It is desirable from nutritional point of view.

The wines with 100 to 300 ppm of sodium benzoate had more volatile acidity than control wine or that 400 ppm sodium benzoate which had lowest volatile acidity. Lowest volatile acidity in this wine could be attributed to lower fermentatability of this treatment, as described earlier. Vyas and Joshi (1982) reported that the tannin content was found to be more in the wine fermented with skin than that without skin whereas the volatile acidity was found to be almost the same in both the wines. According to Joshi and Bhutani (1990), the tannin content was more in the wine treated with sodium benzoate than that of KMS whereas their aldehyde contents were similar. According to Amerine *et al*. (1980) the volatile acidity of wine of less than that 0.04% as acetic acid is considered normal and the wine is rated as satisfactory. From this point of view, the wines of all the treatments can be considered as sound wines. A high volatile acidity that 0.04% as acetic acid indicates acetification which is considered as undesirable in wines.

The data of colour values (Table 1) showed that red colour units, were more in the wine with addition of sodium benzoate but yellow units were more or less comparable. Joshi and Bhutani (1990) found that the wine treated with sodium benzoate was better in colour values compared to that treated with KMS. The results of sensory analysis showed that the product with 100 ppm Sodium Benzoate secured the highest and was adjudged to be the best (Fig 2). As per the result, the best wine was obtained with 100 ppm concentration of Na B. In an earlier, study it was found that the wine prepared by the addition of sodium benzoate was judged to be better in terms of sensory qualities than the KMS treated wine (Joshi and Bhutani, 1990). However, how sodium benzoate effect these parameters of plum wine needs further investigation.

It is concluded that the addition 100/200 ppm of sodium benzoate in the fermentation of plum wine is helpful in better physic-chemical and sensory quality of wine.

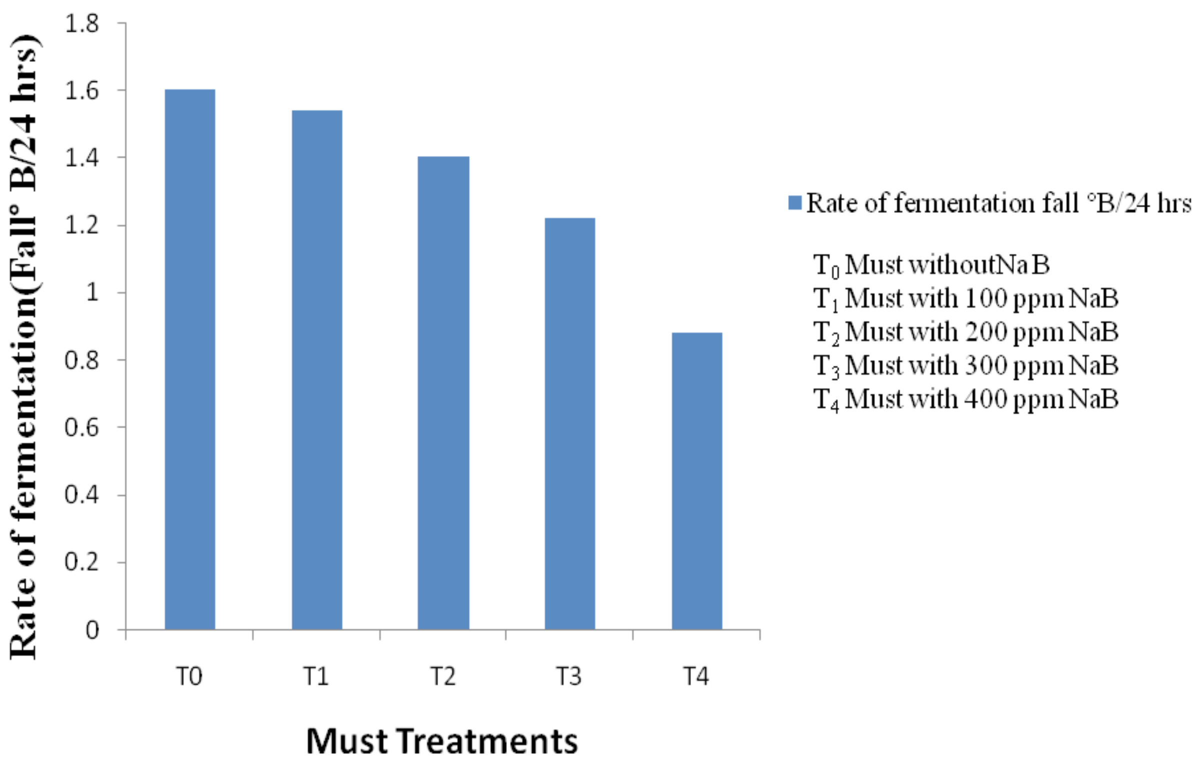

Figure 1. Effect on rate of fermentation of different treatments.

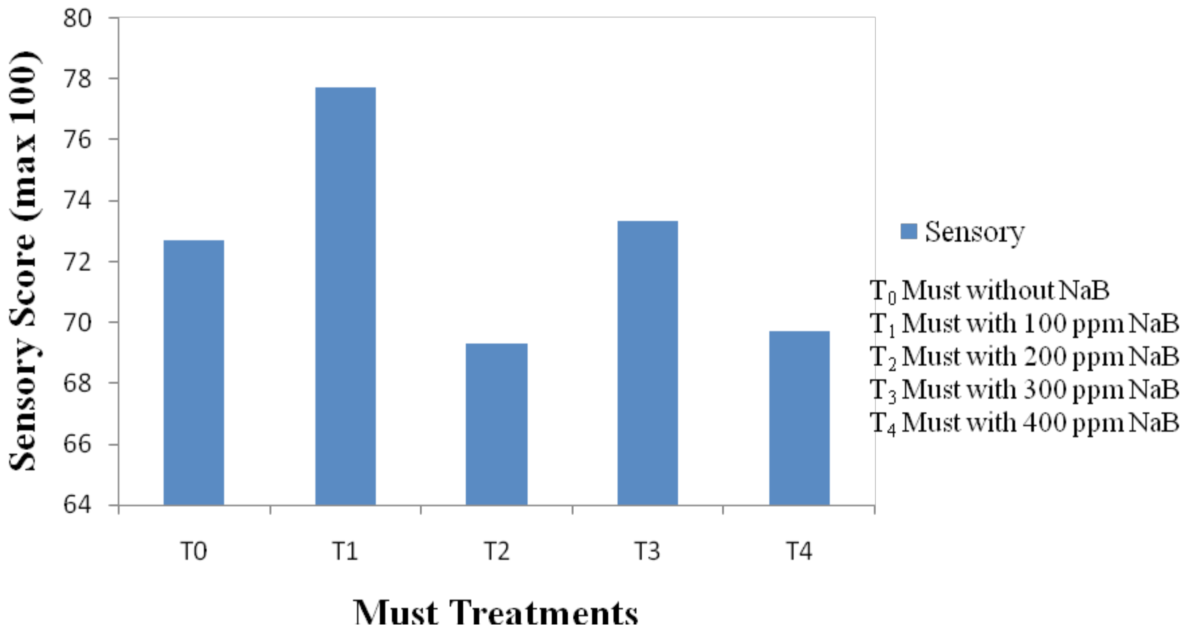

Figure 2. Effect on Sensory of different treatments.

Table 1. Effect of different concentration of sodium benzoate (Na B) on rate of fermentation and physico-chemical characteristics of plum wine

Treatment detail	Rate of fermen-tation (Fall °B/24 hrs)	Total Soluble Solids (TSS) °B	Titratable Acidity (% M.A)	pH	Alochol % (v/v)	Volatile Acidity (%)	Vitamine C (mg/100ml)	Colour (Unit)		
								Red	Yellow	Blue
T_0 = Must without Na B	1.60	8.0 (9.6)	0.82	3.26	11.59	0.024	1.57	6.0	10.1	0.9
T_1 = Must with 100 ppm Na B	1.54	8.6(9.8)	0.86	3.18	10.57	0.030	1.70	7.0	10.5	0.9
T_2 Must with 200 ppm Na B	1.40	10.0(11.2) *	0.86	3.16	7.62	0.030	1.73	7.0	10.9	0.9
T_3 = Must with 300 ppm Na B	1.22	11.8(12.4) *	0.87	3.25	7.11	0.030	1.94	8.0	10.9	0.0
T_4 = Must with 400 ppm Na B	0.88	16.0(16.4) *	0.91	3.19	3.54	0.018	1.73	7.0	0.9	0.0
CD $p \geq 0.05$	0.23	0.6 NA	NS	NS	0.97	0.005	0.19	-	- NA -	-

* Values in parenthesis indicate TSS after blending, NS = Not significant, NA = Not applicable

References

Amerine, M. A., Kunkee, K. E., Ough, C. S., Singleton, V. L and Webb, A. D. 1980. *Technology of wine making*. AVI Publishers Co.Inc. Westport C T. p. 794.

Atkinson, F.E; Bowen, J.F. and MacGregor, D. R. 1959. A rapid method for production of a sparkling apple wine. In Nineteenth *Annual Meeting of the IFT*, Philadelphia, Pennsylvania, 673-675.

Bhutani, V.P and Joshi, V.K. 1995. Plum In: *Handbook of Fruit Science and Technology, cultivation, storage and processing* D K Salunkhe and S S Kadam (ed). M/S Marcel Dekker, USA. Pp. 243-296.

Caputi, A. Jr; Ueda, M. and Brown, J. 1968. Spectrophotometric determination of ethanol in wine. *Am. J. Enol vatic*. **19**: 160-165.

Cockran, W.G. and Cox, G.M. 1963. *Experimental Designs*. Asia Publishing House, Bombay, p 163.

Herraiz, T; Reglero, G; Herraiz, M; Martin-alvarez, P. J. and Cabezudo, M. D. 1990. The influence of the yeast and types of culture on the volatile composition of wines fermented without sulphur dioxide. *Am. J. Enol. Vitic*. **41**(4) : 313-318.

Joshi, V. K. and Bhutani, V. P. 1990. Evaluation of plum cultivars for wine preparation. Abst. In. *International Hort. Cong*., Italy. Abst. No. 3336.

Joshi V. K., Attri, B. L and Mahajan B.V.C. 1991. Physico-chemical and sensory evaluation of vermouth from plum fruits. *J Fd Sci. Technol*., **30**: 208.

Joshi, V.K; Chauhan, S.K. and Lal, B.B. 1993. Extraction of juices from peach, and apricot by pectinolytic treatment *J. Fd. Sci. Technol*. **28**(1): 64-65.

Joshi, V. K. 1997. Fruit Wines. 2nd ed. Directorate of Extension Education. Dr Y S Parmar UHF, Nauni- Solan, India.

Joshi, V.K. 2006. *Sensory Science: Principles and application in evaluation of foods*. Agro-Tech Publi. Academy, Jaipur.`

Joshi, V.K., Sharma, Somesh, Devi, P.M. and Bhardwaj, J.C. 2009(a). Effect of initial sugar concentration on the physic-chemical and sensory qualities of plum wine. *J. North East Foods*, **8**(1 and 2): 1-7.

Joshi, V.K., Sharma, Somesh, and Mutum Preema Devi 2009 (b). Influence of different yeast strains on fermentation behavior, physic-chemical and sensory qualities of plum wine, *Nat. Product Radiant*, 445-451.

Kishore, D.K., Pandey, R.M and Sharma, Y.P. 1991. Plums. In: Temperate fruits: ed. Bose, T.k., Mitra, S. K and Rathore, D.S. Horticulture and allied publishers, Calcutta. Pp. 241-278.

Pilone, G. J; Rankine, B. C. and Hatcher, C. J. 1972. Evaluation of an improved method for measuring volatile acid in wine. *Austr. Wine and Brewing Spirit Rev*. **91**: 62-64, 66.

Rangana, S. 1986. *Handbook of Analysis and Quality Control for Fruit and Vegetable products*, IInd. Edn., Tata McGraw Hill Publishsing Co., New Delhi.

Thakur, N.S; Joshi, V.K.and Thakur, N.K. 2000. Principles and methods of preservation of fruits and vegetables. In: Postharvest Technology of fruits and vegetables. L.R. Verma and V.K.Joshi. eds. Pp 148. The Indian Publishers, New Delhi.

Vyas, K.K and Joshi, V.K. 1982. Plum wine making standardization of methodology, Indian Food Packer, **36**(6): 80-86.

Vyas, K. K. and Joshi, V.K. 1988. Deacidification activity of Schizosaccharomyces pombe in plum musts. *J. Fd. Sci. Technol*. **25**(5): 306-307.

Woodroof, J.G. and Luh, B.S. 1975. Commercial Fruit Processing. The AVI Publishing Company, INC. Westport, Connecticut. p. 710.