

Effect of enzymatic treatment and clarification techniques on the Chemical properties of peach juice (*Prunus persica*)Deepshikha^{1*}, Shailza anand², Piyush kashyap³, Rohit Biswas¹¹ Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara (Punjab), India² Department of Food Science Nutrition and Technology, College of Home science CSKHPKV, Palampur 176062 Himachal Pradesh, India³ Department of Food Engineering and Technology, Sant Longowal Institute of Engineering and Technology, Longowal - 148106 (Punjab) India*E-mail: bansaldeepshikha789@gmail.com**Abstract**

In this study, the consequences of enzyme pectinase and four different clarification techniques (sedimentation, filtration, pectinase and filtration, Kaolin and pectinase) were studied on the physicochemical properties of peach juice. The enzymatic treatment significantly increase the yield of juice reduce its turbidity. The results showed that there was significant decrease in TSS and acidity with enzymatic treatment and storage as well whereas in case of ascorbic acid with enzyme treatment the ascorbic acid content increased and decrease with storage. In case of sugars (Reducing, Non-reducing and total sugars), it increased with both enzyme treatment and storage. Among the clarification techniques, TSS (6.83°B) was observed highest in sedimentation and without enzyme treatment but filtration with enzyme treatment was found to best in case of sugars (Reducing (4.39%), Non-reducing (3.39%) and total sugars(7.93%)). Kaolin and pectinase along with enzyme treatment showed highest value of acidity (0.63%) and ascorbic content (3.04 mg/100g) It can be concluded that peach juice quality can be improved with enzymatic treatment and suitable clarification technique

Introduction

Fruits are considered important nutritional requirement of human beings as they not only meet the quantitative needs to some extent but also supply vitamins and minerals, which improve not only quality of diet but also maintains health. People are attracting towards natural and healthier products and their attention has been rising day-by-day and this has been resulting into amplified utilization of fruit juices and their drinks such as nectars, cocktails, and revitalizing products giving new mixtures and flavours to the fruit products (Matta et al., 2004). The fruit juice industry has become one of the world's biggest agribusinesses (Arsad et al., 2015). In recent years, the interest in fruit and vegetable juices production has increased significantly all over the world due to their benefit values and production quality. Depending upon physicochemical and physical properties of fruit, production of fruit juices can be categorized into several methods and purposes (Arsad et al., 2015).

It belongs to the family Rosaceae and the subfamily Amygdyloideae and termed as commonly as "Aaru" and popularly called as "Peach" in English has been extensively consumed all over world. Peach plays an important role in human nutrition, and can be used in either form as fresh, processed or dried fruit. Peaches (*Prunus persica* (L.) Batsch) are nutritionally and economically essential and they are one of the most popular fruits consumed worldwide. Peach juice also contains a good amount of vitamins A and K (Kant et al., 2018). Cell walls of fruits consist of various complex molecular structures. To get maximum yield of juice it is necessary to achieve maximum breakdown of these compounds. Various treatment methods and enzymes can be used for this purpose (Bora et al., 2017). A Variety of enzymes has been used by various researchers to extract fruit juice from number of fruits such as banana pulp. Pectinase enzyme was found to be most common, among the various enzymes used (Egwin et al., 2013; Tapre et al., 2014). Pre-treatment with the enzymes that are responsible for degrading pectin and other compounds has been examined with the aim to rise

the permeate flux in the reverse osmosis, microfiltration and other filtration methods of fruit juices and other pectin containing liquids because pectin liquids can cause membrane fouling and subsequently a reduction in flux (Rai et al., 2004; Santin et al., 2008; Liew et al., 2017). Juice yield can be enhancing by using enzymes in different fruit juices. Pectin present in the cell wall of fruit can be hydrolysed with the help of pectinolytic enzymes, thus helps in more extraction of juice from fruits (Santin et al., 2008). The pectin can be associated with plant polymers and the cell debris which are fibre-like molecular structure. The cloudiness that they cause is difficult to remove except by enzymatic depectinization. Pectinase hydrolyses pectin and leads pectin–protein complexes to flocculate. The resulting juice has a much lower amount of pectin and a lower viscosity, which facilitates the subsequent filtration process (Hmid et al., 2016). The production of peach fruit juice with exotic characteristics has the potential to be explored based on the new technologies and methods in juices industry. Thus, the aims of this study were to examine the effects of enzyme treatments on the peach fruit juice properties.

Materials and Methods

Procurement of Raw material: Fresh peach fruits free from blemishes were procured from the Department of horticulture, CSKHPKV, Palampur. The Sample of fruit was taken, washed and graded.

Extraction of Juice: Two equal lots of fruits were prepared, peeled and cut into small pieces. One lot was treated with pectinase enzyme at the rate of 500mg/kg of fruit another one left untreated and juice was extracted by using screw type juice extractor.

Clarification of juice: Various methods for clarifications has been applied for fruit juice including sedimentation, filtration, combination of pectinase and filtration and treatment of kaolin and pectinase.

i) Sedimentation: The peach juice was kept overnight to settle down the particles and then clarified juice draws off leaving behind residual part, then clarified juice was bottled pasteurized at $80\pm 5^{\circ}\text{C}$ for 30 minutes.

ii) Filtration: Secondly filtration of juice was carried out with the help of muslin cloth and the filtered juice was bottled and pasteurized at $80\pm 5^{\circ}\text{C}$ for 30 minutes.

iii) Treatment with enzyme pectinase and filtration: The extracted peach juice was treated with enzyme (Pectinase, 500mg/l) and incubate at 40°C for 4 hours. Enzyme treated juice was filtered with muslin cloth, bottled and pasteurized at $80\pm 5^{\circ}\text{C}$ for 30 minutes.

iv) Treatment with Kaolin and pectinase enzyme: The peach juice was treated with Kaolin solution (1g/L) and pectinase enzyme at the rate of 10 ml/L and 500 mg/L respectively. The treated juice was kept overnight to settle down the particles and then siphoned off, bottled and pasteurized ($80\pm 5^{\circ}\text{C}$ for 30 minutes) for further analysis.

Chemical analysis of juice

Peach juice was stored at refrigeration temperature *i.e.* 4°C and analyzed freshly and with the time interval of 1.5, 3.0, 4.5, 6.0 months for its various parameters including yield, total soluble solids (TSS), acidity, ascorbic acid, reducing sugars, non-reducing sugars and total sugars whereas ascorbic acid content and acidity were also being analyzed by AOAC methods (2015).

Statistical analysis

Triplicate of each parameter was taken and statistically analyzed using analysis of variance (ANOVA).

Results and Discussion:

Effect of enzyme treatment on yield of juice: A comparative analysis was done for yield of extracted juice with and without action of pectinase enzyme, and results revealed that there was great difference between the recovery of juice yield as it was increased to 49% (with

enzyme treatment) as compare to 43% (without enzyme treatment). As the sample of juice extracted was undergone different clarifying techniques namely sedimentation, filtration, pectinase and filtration and kaolin and pectinase. So, the value of yield with respect to these parameters have also been analyzed as end product must be in clarified form. The yield of juice was resulted as (71.70%:70.50%), (80.20%:73.0%), (83.00%:82.10%) and (84.10:83.60%) with and without added pectinase enzyme respectively. The enzyme activity of pectinolytic (pectinol) increase the yield of juice from different fruits such as plum, peach and apricot has also been reported by (Joshi et al. 1991). Similar results with increased yield of plum juice were also reported by Chan et al., 1994. Landbo et al.,2006 has also been described the effect of enzymes not only on yield of juice but also reported that there was increase in total phenolic content with proper use of combination of different enzymes. The increase in yield of extraction was found to be higher as breakdown of cell structure increases and helps to release pectin compounds of fruit with addition of enzymes (Shiv, 2015).

Effect on TSS (total soluble solids) of peach juice: Table 1 showed the effect of extraction techniques, clarifying treatments and storage interval on total soluble solids of peach juice. The treatments given to peach juice has significant effect on the TSS and higher TSS (7.36⁰B) was recorded in 'sedimentation' treatment when the juice was extracted from untreated sample. The storage of peach juice has significant decreasing effect on the TSS and the mean value of TSS of fresh peach juice when extracted without and with the addition of enzyme were (8.25⁰B, 8.10⁰B) which decrease to (5.87⁰B, 5.92⁰B) respectively after 6 months of storage. Between the methods used for the extraction of peach juice the values of TSS was higher in juice extracted without the addition of enzyme (6.83⁰B) as compared to juice extracted with addition of pectinase enzyme (6.78⁰B). The decreased TSS value for treated sample might be due to use of filtration methods with enzyme treatment. In other

study, increase in total soluble solids was observed that may be due to action of pectinolytic enzyme on insoluble pectin leads to increase in sugar content (Arsad et al., 2015).

Effect on Acidity of Peach Juice: Acidity of peach juice was also analyzed with and without treatment of enzymes and also analysis was done after storage. Table 2 showed the effect of enzyme as well as storage intervals on acidity as compared to untreated juice. It was observed that there was increase in acidity of enzyme treated juice as compared to untreated juice. Similar results have been reported by Hmid et al., 2016 where enzymatic activity has been checked for pomegranate juice. The treatments given to peach juice has significant effect on the acidity and higher acidity value (0.63% as malic acid) was recorded in 'Kaolin and pectinase' clarifying treatments when the juice was extracted with the addition of pectinase enzyme. The storage of juice has significant decreasing effect on the acidity of peach juice. The mean values of acidity of juice extracted without and with the addition of enzyme were (0.63% and 0.69% as malic acid respectively) which decreased to (0.50% and 0.53% as malic acid respectively) after 6 months of storage. The results were in accordance with the study of Hmid et al., 2016 as with increase in activity of enzymes acidity increases then decreases.

Effect on Ascorbic acid content of peach juice: The data pertaining to the ascorbic acid content of peach juice as affected by extraction techniques, clarifying treatments and storage intervals are given in Table 3. The treatments used for extraction and clarification of peach juice had significant effect on the ascorbic acid content. Higher values were observed when the juice was extracted with the addition of enzyme pectinase as compared to the juice extracted without the addition of enzyme. The mean value of ascorbic acid content of juice extracted (without and with) addition of enzyme were (2.93 and 3.04 mg/100g) respectively. Among the different clarifying treatments used the highest value was recorded in 'Kaolin and pectinase' (3.36 mg/100g) treatment followed by 'sedimentation' (3.27 mg/100g), 'filtration' (2.85 mg/100g) and 'pectinase and filtration' (2.67 mg/100g) when the juice was extracted

with the addition of pectinase enzyme. Between the two methods used for extraction of juice the ascorbic acid content (3.04 mg/100g) was higher in juice extracted with the addition of pectinase enzyme. Light exposure is a factor of considerable significance contributing to the oxidation of ascorbic acid in case of bottled juice. Higher values of ascorbic acid for strawberry juice was observed with high pressure processing of enzymatic treated juice so increase in value of ascorbic acid may be resulted due to use of filtration methods (Rao et al., 2014). In other reports ascorbic content for other fruits found to be reduced that could be due to heat treatments given to fruit juices but there was increase in ascorbic acid content of enzymatically (Rao et al., 2014; Patras et al 2009).

Effect on Sugar content of juice: The results of sugars (reducing, non-reducing and total sugars) of peach juice in relation to extraction technique, clarifying treatments and storage intervals are presented in Table 4, 5, 6 respectively. The extraction technique and clarifying treatments had significant effect on sugars. The values of reducing, non-reducing and total sugars were presented in the range of (3.36 to 4.39%), (2.51 to 3.39%), (6.05 to 7.39%) respectively. Between the extractions techniques, reducing sugars (4.29%), non-reducing sugars (3.07%) and total sugars (7.40%) were higher in the peach juice extracted with the addition of enzyme pectinase. Among the different clarifying techniques used the highest value was recorded in filtration (4.39, 3.39, and 7.93%) for (reducing, non-reducing and total sugars) respectively. The values of sugars (reducing, non-reducing and total sugars) increased significantly with the increase in storage period. The mean value of reducing, non-reducing and total sugars of peach juice extracted with the addition of enzyme and analyzed fresh were 3.47, 2.90 and 6.27% which increased to 5.16, 3.56 and 8.86% respectively after 6 months of storage. Similar results were also reported during the study of sugar palm fruit juice by (Arsad et al., 2015) as initially it was present only in sucrose form but with the enzyme

activity sucrose converted to glucose and fructose which leads to increase total sugars of juice.

Conclusion

The clarity of the juice is an important factor regarding the quality of the juice as it fetches consumer attention for the product in the market. The effect of enzyme treatment and clarification techniques gave the significant difference on the physico-chemical characteristics of peach juice. Total sugars and ascorbic content were increased with enzyme treatment but TSS and acidity was decreased. TSS, acidity and ascorbic acid were decrease with the storage period but reducing, non-reducing and total sugars were increased with storage. Kaolin and pectinase was found best clarification technique for ascorbic acid and acidity of peach juice whereas sedimentation and filtration for TSS and total sugars respectively. In conclusion, the using of combination of enzyme treatment and koalin and peptnase as clarification technique is the most effective foe the production of peach juice

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Table 1: Effect of extraction techniques, clarifying treatments and storage intervals on the

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
TSS ⁰ B	S0	8.70	7.80	8.40	8.10	8.25	8.10	7.80	8.70	8.40	8.10	Between treatments: 0.20
	S1	7.50	6.60	7.20	7.50	7.20	7.50	6.52	7.50	7.20	7.18	
	S2	7.27	6.30	6.60	6.22	6.59	6.90	6.30	6.30	6.30	5.98	Between storage intervals : 0.15
	S3	7.05	5.85	6.00	6.00	6.22	6.00	5.62	6.00	6.30	5.98	
	S4	6.30	5.55	6.00	5.62	5.87	6.00	5.70	6.00	6.00	5.92	
	Mean	7.36	6.42	6.84	6.69	6.83	6.90	6.39	6.78	7.00	6.78	

TSS of peach juice.

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)

Table 2: Effect of extraction techniques, clarifying treatments and storage intervals on the Acidity of peach juice.

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
Acidity (% as malic acid)	S0	0.71	0.62	0.56	0.63	0.63	0.67	0.69	0.70	0.71	0.69	Between treatments: 0.37
	S1	0.61	0.57	0.57	0.58	0.58	0.56	0.62	0.64	0.62	0.61	
	S2	0.56	0.53	0.55	0.56	0.55	0.56	0.60	0.63	0.61	0.60	Between storage intervals: 0.29
	S3	0.59	0.53	0.51	0.51	0.53	0.49	0.59	0.59	0.61	0.57	
	S4	0.54	0.51	0.47	0.48	0.50	0.47	0.53	0.53	0.59	0.53	
	Mean	0.60	0.55	0.53	0.55	0.55	0.55	0.60	0.62	0.63	0.60	

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)

Table 3: Effect of extraction techniques, clarifying treatments and storage intervals on the Ascorbic acid of peach juice.

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
Ascorbic acid mg/100ml)	S0	3.43	3.36	3.71	4.06	3.64	4.06	3.43	3.22	4.20	3.72	Between treatments: 0.08
	S1	3.08	3.22	3.43	3.57	3.32	3.85	3.15	3.08	4.06	3.53	
	S2	2.66	3.01	3.15	3.08	2.97	3.22	3.08	2.73	3.22	3.06	Between storage intervals : 0.0
	S3	2.24	2.73	2.59	2.80	2.59	2.80	2.59	2.31	2.80	2.62	
	S4	1.96	2.45	2.03	2.10	2.13	2.45	2.24	2.03	2.52	2.31	
	Mean	2.67	2.95	2.98	3.12	2.93	3.27	2.89	2.67	3.36	3.04	

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)

Table 4: Effect of extraction techniques, clarifying treatments and storage intervals on the Reducing sugar of peach juice.

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
Reducing sugars (%)	S0	3.09	3.25	3.04	2.87	3.06	3.22	3.43	3.64	3.59	3.47	Between treatments: 0.02 Between storage intervals : 0.01
	S1	3.20	3.58	3.42	3.02	3.30	3.56	3.76	4.04	3.97	3.83	
	S2	3.86	3.98	3.84	3.38	3.76	4.13	4.33	4.27	4.61	4.33	
	S3	4.38	3.94	4.21	3.70	4.05	4.66	5.11	4.36	4.53	4.66	
	S4	5.73	4.39	4.63	3.82	4.64	5.33	5.31	5.41	4.61	5.16	
	Mean	4.05	3.83	3.83	3.36	3.76	4.18	4.39	4.34	4.26	4.29	

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)

Table 5: Effect of extraction techniques, clarifying treatments and storage intervals on the Non-Reducing sugar of peach juice.

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
Non-Reducing sugars (%)	S0	2.22	2.54	2.51	2.30	2.39	2.76	3.60	2.71	2.56	2.90	Between treatments: 0.05 Between storage intervals : 0.04
	S1	2.33	2.67	2.54	2.45	2.49	2.81	3.17	2.76	2.59	2.83	
	S2	2.48	2.82	2.61	2.59	2.62	2.92	3.25	2.90	2.68	2.93	
	S3	2.65	3.25	2.84	2.88	2.90	3.25	3.51	3.25	2.92	3.23	
	S4	2.86	3.54	2.96	3.25	3.15	3.48	3.88	3.60	3.30	3.56	
	Mean	2.51	2.94	2.69	2.69	2.70	3.04	3.39	3.04	2.81	3.07	

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)

Table 6: Effect of extraction techniques, clarifying treatments and storage intervals on the Total sugar of peach juice.

Parameters	Storage periods	E ₀ T ₁	E ₀ T ₂	E ₀ T ₃	E ₀ T ₄	Mean	E ₁ T ₁	E ₁ T ₂	E ₁ T ₃	E ₁ T ₄	Mean	CD (P≤0.05)
Total sugars (%)	S0	5.31	5.79	5.54	5.17	5.45	5.98	6.59	6.36	6.15	6.27	Between treatments: 0.15 Between storage intervals : 0.12
	S1	5.54	6.16	5.97	5.47	5.78	6.37	6.94	6.80	6.56	6.66	
	S2	6.35	6.80	6.46	5.97	6.39	7.05	7.59	7.17	7.30	7.27	
	S3	7.03	7.19	6.80	6.58	6.90	7.91	8.87	7.61	7.45	7.96	
	S4	8.59	7.93	7.60	7.07	7.79	8.81	9.69	9.02	7.92	8.86	
	Mean	6.56	6.77	6.47	6.05	6.46	7.72	7.93	7.39	7.07	7.40	

(S0-Fresh, S1-1.5 months, S2-3.0 months, S3-4.5 months, S4-6.0 months, E₀- Extraction without enzyme, E₁ Extraction with enzyme, T₁- Sedimentation, T₂- Filtration, T₃-Pectinase and Fiteration, T₄- Kaolin and Pectinase)