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Sensory evaluation of clarified banana (*Musa paradisiaca* L.) juice prepared using enzymes

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Abstract
The present investigation entitled "Sensory evaluation of clarified banana (*Musa paradisiaca* L.) Juice prepared using enzymes" was aimed to standardize formulation for the preparation of clarification juice from banana. Clarified i. e. banana juice prepared by using different concentration of enzyme pectinase @ 0%, 0.5%, 1% and cellulase 0%, 0.5%, 1% for changes in sensory qualities during storage period of 6 months at room temperature. Banana clarified juice were prepared using enzymes concentration with different nine treatments. The juice was extracted using muslin cloths and hand pressing of banana pulp. Clarified banana juice pasteurization and packed in glass bottle stored room temperature for six month and periodically evaluated for its sensory quality. Sensory parameters were found decreasing trend during six months of storage. C_0P_2 *i.e.* (cellulase: pectinase, 0:1%) was rated best treatment on the basis of higher sensory scores of colour, taste, flavour and overall acceptability. According to above, it may be suggested that for clarified banana juice using of can be prepared by of the proportion of 1 per cent pectinase.

Keywords: Banana, clear juice, enzymes, pectinase, colour, taste, flavor

Introduction
Banana (*Musa paradisica* L.) is a large herbaceous perennial monocotyledonous and monocarpic plant. Banana belongs to family Musaceae in order Scitamineae. Banana is known as "Apple of Paradise" and "poor man's apple". Origin is in the tropical region of South-East Asia many consider banana as one of the man's first food.

The postharvest management of banana require proper infrastructure like pre cooling chamber, hot water treatment plant, irradiation unit, packaging house and storage house. The most of the banana fruit is consumed as fresh and very small amount is being processed in to value added products *i.e.* Banana puree, powder, wafers, wine, figs, jam, canned slices, dehydrated banana slices, flakes, beverages, vinegar and fruit bar *etc.*

The enzymes are used in processing agricultural and agro-industrial waste, clarification of fruit juices and wines, extraction of vegetable oils, reduction of viscosity of concentrates, fermentation of coffee and tea, production of paper, treatment of natural fibers (linen and remie fibers) and degumming of plant fibers (Jin and Masako, 2001). Pectinases have extensive applications in fruit juice industries in order to improve fruit juice yield and clarify. The use of liquefying enzymes for mash treatment results in improvement of free flowing juice flow which leads to a lower press time even in absence of suitable pressing aids. At the same time pectin is broken down into such an extent that the viscosity of mash is considerably reduced (Sartoglu *et al*., 2001) [8].

Enzymes are expensive products and clearly juice manufacturers would wish to minimize their costs by using the enzymes at their optimum conditions and therefore maximizing their effectiveness and re-using the enzymes (Blandino, 2001) [3]. Clarification is a beneficial step in juice processing and improvement of consumer acceptability. It is often achieved through enzymatic treatment, membranes filtration, or using clarifying aids. The use of commercial pectin enzymes is common in fruit juice processing. The advantages of pectin enzyme use have been to increase the flow of juice, clarity, improve juice yield, and facilitate filtration (Alkorta *et al*., 1998) [2].

Material and method
Mature fruits of banana were used for extraction of pulp. The fruits were washed in running water to remove adhering dirt and dust particles. Then pulp was extracted by manually.

Clarified juice of banana prepared from extraction of banana pulp. The procedure of juice was described in figure 1. Total nine treatments were used for preparation of juice using different concentration of enzymes.

Table 1: detail of Treatment formulation used for banana clarified juice

No. of Treatments	Treatments Combination	Details of treatment combination
T_1	C_0P_0	Control
T_2	C_0P_1	Cellulase 0 % + Pectinase 0.5 %
T_3	C_0P_2	Cellulase 0 % + Pectinase 1%
T_4	C_1P_0	Cellulase 0.5 % + Pectinase 0 %
T_5	C_1P_1	Cellulase 0.5 % +Pectinase 0.5 %
T_6	C_1P_2	Cellulase 0.5 % + Pectinase 1 %
T_7	C_2P_0	Cellulase 1 % + Pectinase 0 %
T_8	C_2P_1	Cellulase 1 % + Pectinase 0.5 %
T_9	C_2P_2	Cellulase 1 % +Pectinase 1 %

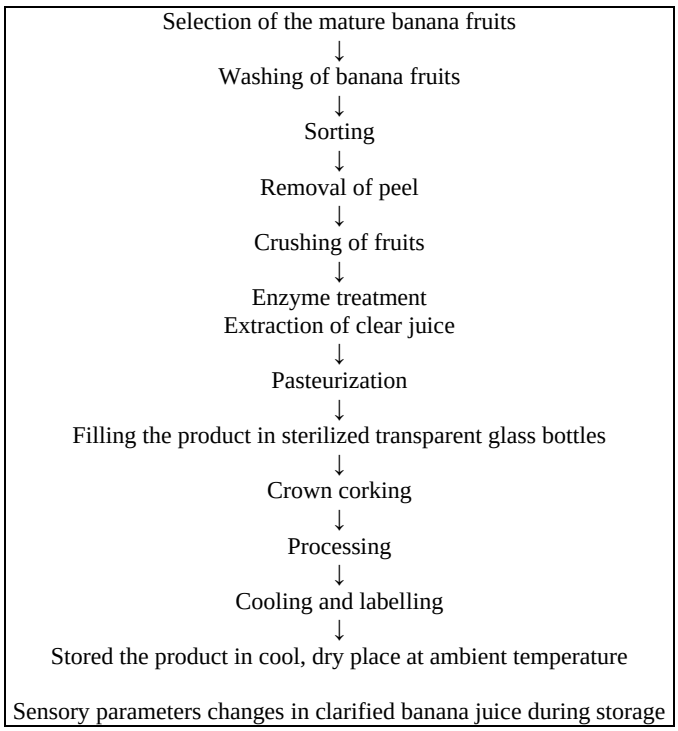

Fig 1: Principal step of juice clarification of banana juice

Results and Discussion

Colour (out of 9 points)

The score of colour in clarified banana juice was found significant. The colour (out of 9 points) contain was found highest in C_0P_2 *i.e.* (pectinase: cellulase, 1:0) which was at par with C_2P_2 *i.e.* (pectinase: cellulase, 1:1) and minimum in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5). The colour score of the product was decreased significantly irrespective of the treatment up to the end of the six months storage. Moreover, the highest colour score was recorded in C_0P_2 *i.e.* (pectinase: cellulase, 1:0) may be due to the enzyme like pectinase breakdown the particles, hence improve the sensory qualities in terms of colour. The lowest colour score was recorded in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5) which could be mainly due to the enzyme like cellulase its give dark colour. The pattern of decline of colour during storage might be due to the oxidation, which was responsible for increase the production of black compounds resulting in browning of product during long term storage and thus it's adversely affected on colour acceptance. These observations were also similar to finding of Sin *et al*. (2006) [11] clarification of sapodilla juice, Vaidya *et al*. (2009) in enzymatic extraction of kiwifruit juice, Joshi *et al*. (2011) [6] in pectinase enzyme on clarification of apple juice, Akesowan and Choonhahirun (2013) [1] pectinase enzyme on clarification of guava juice, Egwim *et al.* (2013) [4] clarification of banana juice, Kadam *et al.* (2014) [7] in effect of pectinase enzyme on clarification of grape juice, Sharma *et al*. (2014) [9] in enzymatic extraction and clarification of juice from various fruits, Sherpa *et al*. (2014) [10] in enzymes assisted juice extraction from plum.

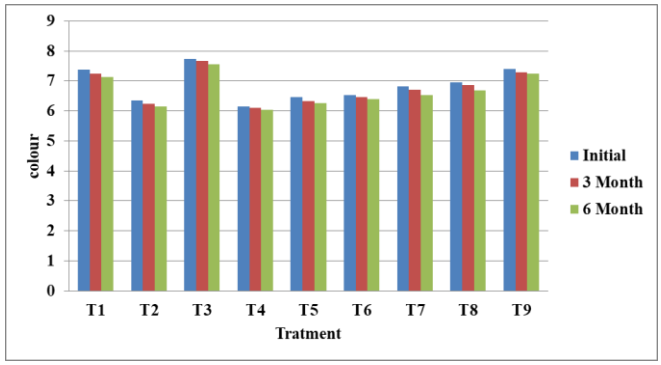

Fig 2: Effect of enzyme on colour of clarified banana juice during storage

Taste (out of 9 points)

The score of taste in clarified banana juice was found significant. The maximum taste score was recorded in C_0P_1 *i.e.* (pectinase: cellulase, 0.5:0) which was at par with C_2P_2 *i.e.* (pectinase: cellulase, 1:1). However, the minimum score in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5). The taste score of the product was decreased significantly irrespective of the treatment up to the end of the six month storage. Moreover, the highest taste score was recorded in C_0P_1 *i.e.* (pectinase: cellulase, 0.5:0) may be due to the pulp particles contain air and later on results in the development of oxidative changes. The lowest taste score was recorded in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5) may be due to the enzyme like cellulase its give bitter taste. The pattern of decline of taste during storage might be due to the biochemical changes like increase in TSS, sugars and acidity as well as decrease ascorbic acid during storage. These observations were also similar to finding of Sin *et al*. (2006) [11] clarification of sapodilla juice, Vaidya *et al*. (2009) in enzymatic extraction of kiwifruit juice, Joshi *et al*. (2011) in pectinase enzyme on clarification of apple juice, Egwim *et al*. (2013) [4] clarification of banana juice, Kadam *et al*. (2014) [7] in effect of pectinase enzyme on clarification of grape juice, Sherpa *et al*. (2014) [10] in enzymes assisted juice extraction from plum.

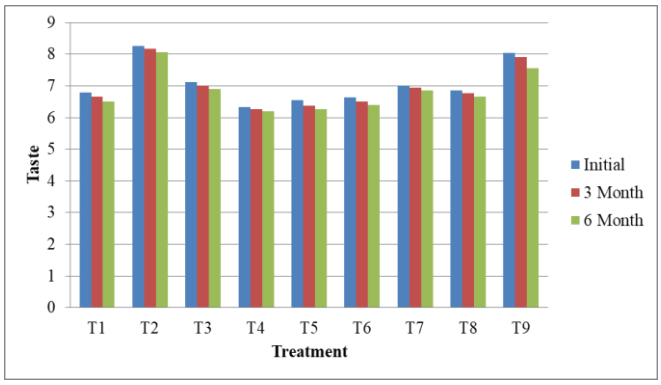

Fig 3: Effect of enzyme on taste of clarified banana juice during storage

Flavour (out of 9 points)

The score of flavour in clarified banana juice was found significant. The flavour (out of 9 points) contain was found significantly highest in C_0P_2 *i.e.* (pectinase: cellulase, 1:0) which was at par with C_0P_1 *i.e.* (pectinase: cellulase, 0.5:0) and minimum score in C_0P_0 *i.e.* (pectinase: cellulase, 0:0). The flavour score of the product was decreased significantly irrespective of the treatment up to the end of the six months storage. Moreover, the highest flavour score was recorded in C_0P_2 *i.e.* (pectinase: cellulase, 1:0) may be due to the pulp particles contain air and later on results in the development of oxidative changes. The lowest flavour score was recorded in C_0P_2 *i.e.* (pectinase: cellulase, 0:0) may be due to enzymes concentration was zero. The pattern of continuously decrease in flavour score during storage might be due to the loss of highly volatile aromatic compound which is very sensitive to high storage temperature. Similar types of results were also in accordance with Sin *et al.* (2006) clarification of sapodilla juice, Vaidya *et al.* (2009) in enzymatic extraction of kiwifruit juice, Joshi *et al.* (2011) [6] in pectinase enzyme on clarification of apple juice, Egwim *et al.* (2013) [4] clarification of banana juice, Kadam *et al.* (2014) [7] in effect of pectinase enzyme on clarification of grape juice, Sherpa *et al.* (2014) [10] in enzymes assisted juice extraction from plum.

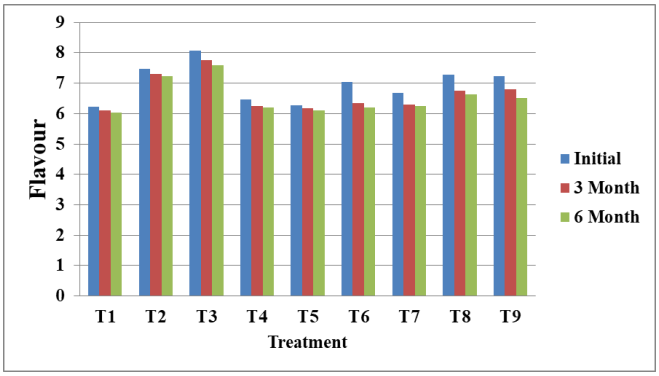

Fig 4: Effect of enzyme on flavour of clarified banana juice during storage

Overall acceptability (out of 9 points)

The score of overall acceptability in clarified banana juice was found significant. The overall acceptability contain was found highest in C_0P_2 *i.e.* (pectinase: cellulase, 1:0) which was at par with C_0P_1 *i.e.* (pectinase: cellulase, 0.5:0) and minimum in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5). The overall acceptability score of the product was decreased significantly irrespective of the treatment up to the end of the six months storage. In overall acceptability of juice considering the colour, taste and flavor the treatment C_0P_2 *i.e.* (pectinase: cellulase, 1:0) was found more acceptable. It may be due to the enzyme like pectinase breakdown the particles, hence improve the sensory qualities in terms of sensory. The lowest overall acceptability score was reported in C_1P_0 *i.e.* (pectinase: cellulase, 0:0.5) may be due to the enzyme like cellulase it's give bitter taste and dark colour which was responsible for lowest acceptance in the overall acceptability of juice. The pattern of continuously decrease in overall acceptability score during storage might be due to the decline the all sensory parameters like colour, taste and flavour with increasing storage period. Such identical findings were also revealed by Sin *et al.* (2006) [11] clarification of sapodilla juice, Vaidya *et al.* (2009) in enzymatic extraction of kiwifruit juice, Joshi *et al.* (2011) [6] in pectinase enzyme on clarification of apple juice, Egwim *et al.* (2013) [4] clarification of banana juice, Kadam *et al.* (2014) [7] in effect of pectinase enzyme on clarification of grape juice, Sherpa *et al.* (2014) [10] in enzymes assisted juice extraction from plum.

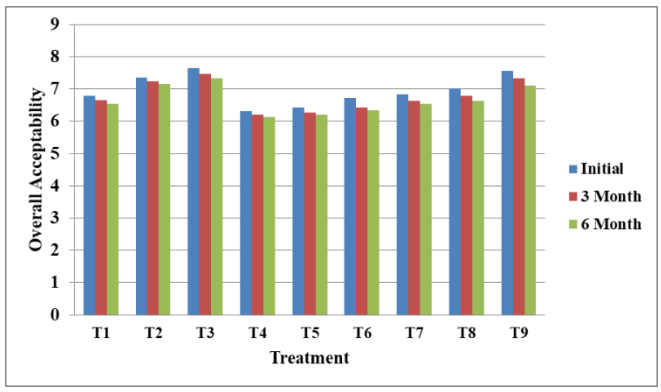

Fig 5: Effect of enzyme on overall acceptability of clarified banana juice during storage

Conclusion

The overall data concluded that sensory evaluation in respect to colour, taste, flavour and overall acceptability C_0P_2 *i.e.* (pectinase: cellulase, 1:0) was found best while, C_0P_1 *i.e.* (Pectinase: cellulase, 0.5:0) was equally best in respect to above characters. The cost of production of clarified banana juice was found maximum in C_2P_2 *i.e.* (pectinase: cellulase, 1:1) with high benefit: cost ratio, while the lowest cost of production was recorded in C_0P_0 *i.e.* (pectinase: cellulase, 0:0) with low benefit: cost ratio.

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