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Vishwas R Kekan
Post Graduate Institute of Post-Harvest Management Killa-Roha, Department of Post-Harvest Management of Fruit Vegetable and Flower Crops, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Dr. Pradip P Relekar
Post Graduate Institute of Post-Harvest Management Killa-Roha, Department of Post-Harvest Management of Fruit Vegetable and Flower Crops, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Vishal B Yadav
Post Graduate Institute of Post-Harvest Management Killa-Roha, Department of Post-Harvest Management of Fruit Vegetable and Flower Crops, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Corresponding Author:
Vishwas R Kekan
Post Graduate Institute of Post-Harvest Management Killa-Roha, Department of Post-Harvest Management of Fruit Vegetable and Flower Crops, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Development of pineapple (*Ananas comosus* L.)-kokum (*Garcinia indica* choisy.) blended jelly with studying changes in the physical and sensory quality parameters during storage

Vishwas R Kekan, Dr. Pradip P Relekar and Vishal B Yadav

Abstract
An experiment entitled, "Development of pineapple (*Ananas comosus* L.) - kokum (*Garcinia indica* choisy.) blended jelly with studying changes in the physical and sensory quality parameters during storage" was conducted in the Department of Post-Harvest Management of Fruit, Vegetable and Flower Crops, Post Graduate Institute of Post-Harvest Management., Killa-Roha during the year 2018-2019. It was aimed to develop the blended jelly cubes by using various proportions of pineapple and kokum juices *viz.* 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 and 0:100. The pineapple – kokum blended jelly was evaluated for physical and sensory quality parameters during 90 days of storage period. The colour of the blended jelly was determined by recording L*, a* and b* values. L* value was decreased from 60.33 to 47.13 during storage indicating the increase in darkness of colour of the blended jelly. Moreover, an increase in a* value from 23.24 to 32.25 and a decrease in b* value from 26.42 to 20.40 was observed in the blended jelly during storage. Sensory evaluation of the pineapple – kokum blended jelly showed that the sensory score for colour, flavour and texture decreased during storage. Based on the organoleptic evaluation and economics of the jelly, the pineapple and kokum blended jelly could be prepared by blending pineapple and kokum juice in the ratio of 60:40 with optimum consumer acceptability up to 90 days of storage at ambient condition.

Keywords: Pineapple, kokum, physical, sensory quality parameters and storage, etc.

1. Introduction
Pineapple (*Anana scomosus*) is one of the most important horticultural crops and is the third most important tropical fruit in the world after banana and citrus in terms of production. The world total annual production of pineapple during the year 2016-2017 was 67,434 tonnes (Anon 2017 a) [5]. The area under pineapple cultivation in India is 1,11000 ha, with a production of 1861thousandtonnes and a productivity of 16.8 metric tonnes/ha (Anon., 2017b) [6]. According to Samson (1986) [35], the pineapple mainly contains water, carbohydrates, sugars, vitamin A, vitamin C and β carotene. It contains low amounts of protein, fat, ash, fiber and antioxidants namely flavonoids in addition to citric and malic acid and moderate amounts of ascorbic acid (Tochi *et al*., 2008) [40]. Pineapple is cultivated predominantly for its fruit that is consumed fresh or as canned fruit and juice. Pineapple is the only source of bromelain, a complex proteolytic enzyme used in the pharmaceutical market and as a meat-tenderizing agent. The stems and leaves of pineapple plant are also a source of fibre that is white, creamy and lustrous as silk. Pineapple fibre has been processed into paper with remarkable qualities of thinness, smoothness and pliability. Parts of the plant are used for silage and hay for cattle feed. Processing wastes in the form of shell, core materials and centrifuged solids from juice production are also used as animal feed. The alcoholic beverages can also be made from juice (Anon., 2018) [7].
Nearly 80 per cent of pineapple production found in the market is in the processed form, out of which 48 per cent is used for concentrated juice and 30 per cent for canned fruits in the world (Saad, 2004) [34]. The processed products prepared from pineapple are mainly slices in tins, juice, squash, dehydrated slices and jam. Fruit core is also used for preparing candy.
Diversification of pineapple products is a good strategy to increase consumption in the main markets of the world. Thus, pineapple is now consumed in the form of single strength or concentrated juice, dehydrated and sugared, canned slices or bits. The newer developments are dried chips, cocktail-type drinks, dried powdered, isotonic mixtures and wine;

there are also new canned forms as whole fruit, bars, flakes and cubes (Coveca, 2002) [12].

Kokum (*Garciniaindicachoisy.*) is an important minor fruit crop known by different English names such as wild mangosteen or red mango. In India, it is known by names such as Bindin, Biran, Bhirand, Bhinda, Katambi, Panarpuli, Ratambaor Amsool, etc. *Garciniaindica* belongs to the botanical family of Clusiaceae or according to the old classification it belongs to the family of Guttiferae which has approximately 1350 species. Clusiaceae is further divided into five sub-families, one of which is Clusioideae. Sub-family Clusioideae has two tribes Clusieae and Garcicieae and Garcicieae has two genera namely *Garcinia* and *Mammea*. The genus *Garcinia* contains 200 species out of which over 20 are found in India (Patil *et al*., 2005) [37].

Kokum is one of the most important minor fruits which is of commercial value and found to grow luxuriously in the forest of the western Ghat of Maharashtra (Shingare *et al*., 2005) [37]. According to the survey reports in the state of Maharashtra, out of the total 46,000 Kokum trees, 43,000 trees are existing in Ratnagiri and Sindhudurg districts alone. Thus, Konkan region is enjoying the monopoly status with respect to kokum fruit production.At present, India produces 10,200 metric tonnes of kokum with productivity of 8.5 tonnes/ha (Nayak *et al*., 2010) [27].

The fruit is cardio tonic, anthelmintic, anti-acidic and useful in piles, dysentery, tumors and pains. Kokum butter is considered nutritive, demulcent, astringent and emollient. It is suitable for ointments, suppositories (Samantha and Krishnamurthy, 1982) [21]. Kokum rind is rich-source of hydroxycitric acid (HCA) which lowers the blood lipids.

Every 100 g of kokum fruit contains 80.00 g moisture, 1.92 g protein, 2.57 g total ash, 2.85 g tannins, 5.71 g Pectin, 4.1 g total sugar, 10.00 g crude fat, 0.06 ascorbic acid, 2.40 anthocyanins. (Krishnamurthy *et al*., 1982) [21].

The pineapple juice has excellent flavour and hence very much suitable for the preparation of jelly. As the kokum is rich in anthocyanin pigment, the kokum rind juice could be used as a bio-colourent in pineapple jelly, Moreover, it may not be required to use citric acid to maintain required acidity if kokum juice is added in proper proportion in the pineapple jelly since the kokum is highly acidic in nature. With this view, the present investigation was carried out to develop the pineapple – kokum blended jelly with following objectives.

1. To standardize the proportion of pineapple - kokum juice in the blended jelly.
2. To study the storage behaviour of pineapple– kokum blended jelly.

2. Material and Methods

The present research entitled, "Development of pineapple (*Ananas comosus* L.) - kokum (*Garcinia indica* choisy.) blended jelly with studying changes in the physical and sensory quality parameters during storage" was conducted at the Department of Post-Harvest Management of Fruit, Vegetable and Flower Crops, Post Graduate Institute of Post-Harvest Management, Killa-Roha, Dist. Raigad, during the year 2018-2019.

2.1. Experimental material

The mature pineapple fruits of local type were procured from the local farmers from Raigad district (MS) and the kokum fruits required for conducting research were obtained from the kokum orchards of Dr. Balasaheb Sawant Kokan Krushi Vidyapeeth, Dapoli. After washing, fruits were used for the preparation of jelly. For making jelly, the pectin, sugar and chemicals like citric acid and sodium benzoate were used. The above material was procured from the Department of Post-Harvest Management of Fruit, Vegetable and Flower Crops, Post Graduate Institute of Post-Harvest Management, Killa-Roha, Dist. Raigad.

2.1.1 Experimental details

Crop	Pineapple (*Ananas comosus*L.)and Kokum (*Garcinia indica* choisy.)
Cultivar	Local type
Design	Factorial Completely Randomized Design (FCRD)
Number of treatment combinations	7 × 4 = 28
Replications	3

2.1.2 Treatment details

A. Main treatments

Treatments	Proportion of pineapple - kokum juice
T_1	100:00
T_2	90:10
T_3	80:20
T_4	70:30
T_5	60:40
T_6	50:50
T_7	00:100

B. Sub treatments

Sub treatments	Storage period (Days)
S_1	0
S_2	30
S_3	60
S_4	90

2.2 Methods

2.2.1 Physical parameters of pineapple and kokum:

2.2.1.1 Juice recovery

The consumable part of the fruit was weighed and known amount was taken for blending. The blended homogenized pulp was passed through a set of muslin cloth to separate the solid particles. The juice was collected in a measuring cylinder and recovery of juice content was given as follows.

$$\text{Juice recovery (\%)} = \frac{\text{Volume of juice}}{\text{Weight of fruit}} \times 100$$

2.2.1.2 Colour

The colour of pineapple and kokum juice was measured by using colorimeter (make Konica Minolta, Japan CR-400) and expressed as L*, a* and b* values.

2.2.2 Chemical parameters of pineapple and kokum:

2.2.2.1 Moisture

The moisture content was measured directly by using Contech moisture analyzer (model CA-123) at 100 ^{0}C temperature and expressed as per cent moisture content on electronic display directly.

2.2.2.2 Total Soluble Solids
The total soluble solids were determined by using Hand Refractometer (Atago Japan, 0-32^{0}B) and the values were corrected at 20 ^{0}C with the help of temperature correction chart (AOAC, 1975) [1].

2.2.2.3 Titratable acidity
A known quantity of sample was titrated against 0.1 N NaOH solution using phenolphthalein as an indicator (AOAC, 1975) [1]. The sample of known quantity with 20 ml distilled water was transferred to 100 ml volumetric flask, made up the volume and filtered. A known volume of aliquot (10 ml) was titrated against 0.1N sodium hydroxide (NaOH) solution using phenolphthalein as an indicator (Ranganna, 2003) [31]. The results were expressed as per cent anhydrous citric acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Normality of alkali X Titre reading X Volume made X Equivalent weight of acid}}{\text{Weight of sample taken X Volume of sample taken for estimation X 1000}} X100$$

2.2.2.4 Reducing sugars
The reducing sugars were determined by the method of Lane and Eynon (1923) [22] as described by Ranganna (2003) [31]. A known weight of sample was taken in 250 ml volumetric flask. To this, hundred ml of distilled water was added and the contents were neutralized by 1 N sodium hydroxide. Then, 2 ml of 45 percent lead acetate was added to it. The contents were mixed well and kept for 10 minutes. Two ml of 22 percent potassium oxalate was added to it to precipitate the excess of lead. The volume was made to 250 ml with distilled water and solution was filtered through Whatman No. 4 filter paper. This filtrate was used for determination of reducing sugars by titrating it against the boiling mixture of Fehling 'A' and Fehling 'B' solutions (5 ml each) using methylene blue as indicator to a brick red end point. The results were expressed on per cent basis.

$$\text{Reducing sugars (\%)} = \frac{\text{Factor X Dilution}}{\text{Titre reading X Weight of sample}} \text{ X } 100$$

2.2.2.5 Total sugars
For inversion at room temperature, a fifty ml aliquot of clarified deluded solution was transferred to 250 ml volumetric flask, to which, 10 ml of 50 percent HCl was added and then allowed to stand at room temperature for 24 hrs. It was then neutralized with 40 percent NaOH solution. The volume of neutralized aliquot was made to 250 ml with distilled water. This aliquot was used for determination of total sugars by titrating it against the boiling mixture of Fehling 'A' and Fehling 'B' (5ml each) using methylene blue as indicator to a brick red end point. The results were expressed on percent basis.

$$\text{Total sugars (\%)} = \frac{\text{Factor X Dilution}}{\text{Titre reading X Weight of sample}} \text{X } 100$$

2.2.2.6 Preparation of jelly
The product was prepared as per the steps given below.

2.2.6.1 Extraction of juice
Fresh ripe pineapple fruits were peeled and sliced. The slices were then communized in the mixer grinder. The prepared pulp was squeezed through muslin cloth for juice extraction. The fresh, ripe, mature kokum fruits were selected, washed, cut into two halves and the juice from fruit rind was extracted by pressing the kokum rind with the help of basket press and the preservative i.e. sodium benzoate @ 1000 ppm/kg was added in the juice.

2.2.6.2 Straining of juice
The pineapple and kokum juice was strained through four fold muslin cloth to remove all colloidal particles.

2.2.6.3 Blending of juices
The juices of pineapple (Cv. Local) and kokum were blended in different proportions as per the treatments.

2.2.6.4 Addition of sugar
The sugar was added in 1:1 proportion in the pineapple and kokum blended juice.

2.2.6.5 Boiling
After addition of the sugar, the mixture was boiled as rapidly as possible to avoid destruction of pectin as well as to maintain the colour and flavour of the jelly. The scum was removed with the help of spoon as and when it appeared.

2.2.6.6 Addition of pectin
Out of the total required sugar, 1/10th part of sugar was mixed with 2 percent pectin powder so as to dissolve the pectin easily in juice. After reaching 55^{0}B TSS, the pectin sugar mixture was added into mixture with continuous stirring to avoid loss of jelly forming strength of pectin.

2.2.6.7 Addition of citric acid
Upon reaching 60^{0}B TSS, the citric acid was added @ 0.5 percent in order to prevent sucrose crystallization in the finished product and to establish the optimum gel formation.

2.2.6.8 Filling, capping and processing of jelly
When the TSS of jelly reached to 68^{0}B, the blended jelly was poured hot in the sterilized glass bottles and capped. Glass bottles were then processed for 10 minutes in boiling water. The bottles were stored in ambient condition for further investigation.

2.2.4 Product recovery
The product recovery of guava and pineapple bar was recorded based on total weight of product. The per cent recovery was calculated as given below.

$$\text{Product recovery (\%)} = \frac{\text{Weight of product}}{\text{Initial weight of mixture}} \text{ x } 100$$

2.2.5 Changes in the physical quality parameters of the pineapple – kokum blended jelly during storage
2.2.5.1 Colour
The colour of blended pineapple and kokum jelly was

measured by using colorimeter (make Konica Minolta, Japan CR-400) and expressed as L*, a* and b* values.

2.2.6 Changes in sensory quality parameters of the pineapple –kokum blended jelly during storage

Blended pineapple and kokum jelly cubes were evaluated for their organoleptic qualities like colour, flavour, texture and overall acceptability on a hedonic scale (Amerine *et al*., 1965) [4] as given below.

Organoleptic Score	Rating
9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

The overall rating was obtained by averaging the score for colour, flavour and texture of pineapple – kokum blended jelly. The samples with score of 5.5 and above were rated as acceptable.

2.2.7 Statistical analysis of the pineapple –kokum blended jelly

The data collected on chemical parameters of pineapple and kokum such as moisture, TSS, titratable acidity and sugars were represented as mean values. The data collected on the changes in physical and sensory quality parameters of blended pineapple and kokum jelly during storage were statistically analyzed by the standard procedure given by Panse and Sukhatme (1985) [29] and Amdekar (2014) [3] using Factorial Completely Randomized Design and valid conclusions were drawn only on significant differences between treatment mean at 5 percent level of significance.

2.2.8 Economics of the pineapple – kokum blended jelly

The economics of the product was worked out by considering existing rates of various inputs such as cost of raw material (fruits), labour, fuel, chemicals, packaging material, depreciation charges (repairing charge) and interest on the fixed capital. The gross returns as per the treatments were worked out by considering prevailing market price. The sale price of the product was common for all the treatments of the experiment and benefit–cost ratio was worked out for each treatment.

Flow chart-I

Extraction of pineapple juice

Selection of fruits
↓
Washing and cleaning of fruits
↓
Peeling and cutting
↓
Pulping
↓
Squeezing the pulp through muslin cloth for juice extraction
↓
Addition of preservative i.e. potassium metabisulphate@ 1000 ppm

Flow chart-II

Extraction of kokum juice

Selection of kokum fruits
↓
Washing of fruits
↓
Preparation of fruits (Removal of Stalks and cutting them into two halves)
↓
Extraction of juice from fruit rind
↓
Straining of juice
↓
Addition of preservative i.e. sodium benzoate @1000 ppm

Flow sheet-III

Preparation of pineapple –kokum blended jelly

Selection of pineapple and kokum fruits
↓
Cleaning and washing
↓
Extraction of juice
↓
Straining of juice
↓
Blending of juices in different Proportions as per the treatments
↓
Addition of sugar in 1:1 proportion
↓
Heating the mixture
↓
Addition of pectin@ 1.0 per cent
↓
Continue heating
↓
Addition of citric acid to maintain 0.5per centacidity
↓
Heating mixture to TSS level of 68°Brix
↓
Hot filling in the pre-sterilized glass bottles
↓
Capping of bottles
↓
Processing of bottles for 10 minutes in boiling water
↓
Cooling
↓
Labeling
↓
Storing at ambient temperature

3. Results and Discussion

The present investigation entitled, “Development of pineapple (*Ananas comosus* L.) - kokum (*Garcinia indica* choisy.) blended jelly with studying changes in the physical and sensory quality parameters during storage” was undertaken in

the Department of Post-Harvest Management of Fruit, Vegetable and Flower Crops, Post Graduate Institute of Post-Harvest Management, Killa-Roha, Dist.- Raigad, during the year 2018-2019.

The studies were carried out to standardize the proportion of pineapple and kokum juices for the preparation of jelly and to study the storage behaviour of pineapple - kokum blended jelly. The experiment consisted of pineapple and kokum juices in different proportions i.e. 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 0:100.

3.1 Physical parameters of pineapple and kokum

The data related to the physico-chemical parameters of pineapple and kokum fruit are presented in Table 1.

Table 1: Physico-Chemical parameters of pineapple and kokum fruit

Sr. No.	Parameters	Pineapple	Kokum
A. Physical parameters			
1.	Juice recovery (%)	71.10	22.6
2.	Colour value L*	88.81	47.61
3.	Colour value a*	0.97	47.96
4.	Colour value b*	4.50	34.37
B. Chemical parameters			
1.	Moisture content (%)	84.00	82.24
2.	Total soluble solids (^{0}B)	12.00	7.2
3.	Titratable acidity (%)	0.51	2.3
4.	Reducing sugars (%)	8.22	2.64
5.	Total sugars (%)	10.90	6.30

*Values are the average (mean) of three observations.

3.1.1 Juice recovery (%)

The data regarding juice recovery of pineapple fruit presented in Table 1 revealed that the average juice recovery of pineapple fruit was 71.10 per cent. The similar observation was reported by Khalid *et al*. (2016) [18] in pineapple fruit juice. The recovery of kokum juice was recorded as 22.6 per cent on the weight basis.

3.1.2 Colour

The mean colour in terms of tri-stimulus L*, a* and b*values of pineapple fruit juice was recorded as 88.81, 0.97 and 4.50, respectively. Identical results were also recorded by the Assawarachan and Noomhorm (2010) [9] in pineapple juice. The mean colour in terms of tri-stimulus L*, a* and b*values of kokum rind juice was recorded as 47.61, 47.96 and 34.37, respectively.

3.2 Chemical parameters of pineapple and kokum fruit:

The data related to the chemical parameters of pineapple and kokum are presented in Table 1.

3.2.1 Pineapple

3.2.1.1 Moisture

Moisture content of pineapple was recorded as 84.00 percent. Closely related result for moisture content of pineapple fruit was observed by Hossain *et al.* (2015) [16]. They recorded 81 to 85 per cent moisture content in pineapple fruit.

3.2.1.2 Total Soluble Solids:

The total soluble solids content of the pineapple fruit was 12.00ºBrix.Similar results were reported by Balaswamy (2013) [10] who observed that the ripe pineapple fruits had 12 ^{0}Brix total soluble solids.

Expedito *et al*. (1996) [15] reported that the fully ripe, medium sized Queen variety of pineapple had 10 to 12 ºBrix TSS.

3.2.1.3 Titratable acidity

It was observed that the titratable acidity of the pineapple fruit juice was 0.51 percent. Identical results are recorded by, Balaswamy *et al*. (2013) [10] who reported that the ripe pineapple fruit juice had 0.46 percent acidity and Khurdiya (1987) [19] reported0.3 to 0.8 percent acidity of pineapple juice.

3.2.1.4 Reducing sugars

The reducing sugar content of 8.22 percent was recorded in the pineapple fruit, Similar results were recorded by the Balaswamy *et al.* (2013) [10] who observed that the reducing sugar content in ripe pineapple fruit juice was 8.4 percent.

3.2.1.5 Total sugars

The data presented in Table 1 indicate that the total sugar content in the pineapple was 10.19 per cent Balaswamy *et al.* (2013) [10] also reported that the ripe pineapple fruit juice had 10.6 percent.

3.2.2 Kokum

3.2.2.1 Moisture

Moisture content of kokum juice was recorded as 82.24 per cent. Closely related result for moisture content of kokum fruit was observed by Krishnamurthy *et al*. (1982) [21]. They recorded 80 to 82 per cent moisture content in kokum fruit.

3.2.2.2 Total Soluble Solids

From results presented in the Table 1, it can be seen that the TSS of ripe kokum was 7.2 °Brix. The observations analogus to these findings were reported by Nair (1986) [25], Joshi (1994) [17], Sawant *et al*. (1997) [36], Dalvi (1998) [13] in kokum, Chavan (1997) [11] and Marathe (1989) [23] in cashew apple.

3.2.2.3 Titratable acidity

It is observed from the data presented in Table 1 that per cent titratable acidity of kokum juice was 2.3. The observations in accordance with these findings were reported by Nair (1986) [1]984 [25], Sawant *et al*. (1997) [36] in kokum and Nanjundaswamy (1984), Chavan (1997) [11] and Marathe (1989) [23] in cashew apple.

3.2.2.4 Reducing sugars

The data pertaining to the mean reducing sugar content in the kokum juice was 2.64 per cent as presented in Table 1. The observation in accordance with this findings reported by Nair (1986) [25], Sawant *et al*. (1997) [36] in kokum, Nanjundaswamy (1984) [26], Chavan (1997) [11], Marathe (1989) [23] in cashewapple and Asgekar (2002) [8] in pineapple.

3.2.2.5 Total sugars

The data given in the Table 1 shows that the total sugar content of kokum juice was 6.30 per cent. Identical observation was also reported by Nair (1986) [25], Sawant *et al*. (1997) [36] in kokum. Nanjundaswamy (1984) [26], Chavan (1997) [11] and Marathe (1989) [23] in cashew apple and Asgekar (2002) [8] in pineapple.

3.3 Per cent recovery of the product

It was observed that the per cent recovery of blended bar on total weight basis was in the range of 73.64 to 76.13 per cent. The treatment T_1 [pineapple (100%): kokum (0%)] recorded the highest (76.13%) per cent recovery, followed by the treatment T_2 [pineapple (90%): kokum (10%)], T_3 [pineapple (80%): kokum (20%)] and T_4 [pineapple (70%): kokum (30%)]. The lowest (73.64%) per cent recovery was observed in the treatment T_7 [pineapple (0%): kokum (100%)] followed by the treatments T_6 [pineapple (50%): kokum (50%)] and T_5 [pineapple (60%): kokum (40%)].

As the pineapple juice percentage in blended jelly was increased, the per cent recovery of blended jelly on total weight basis increased. It was noted that there was increase in the net yield of the product with increasing the level of pineapple juice in the blended jelly.

3.4 Changes in the physical parameters of the pineapple - kokum blended jelly during storage

3.4.1 Colour

Colour of jelly was evaluated by recording L* value for lightness, a* value for redness and b* value for yellowness with digital colorimeter (make Konica Minolta, Japan).

3.4.1.1 L* value for colour

The data for L* value for colour of pineapple - kokum blended jelly during storage are presented in Table 2 and depicted in Fig 1.

Table 2: Effect of different proportions of pineapple and kokum juices on L* value for colour of blended jelly during storage

Treatments	L* value for colour				Mean
	Storage period (Days)				
	0	30	60	90	
T1	83.58	75.49	68.76	67.94	73.94
T2	62.73	57.26	55.28	53.84	57.28
T3	61.14	55.09	50.70	48.34	53.82
T4	57.32	51.47	47.76	45.88	50.61
T5	54.04	47.08	43.18	40.04	46.08
T6	52.78	45.78	42.35	38.14	44.76
T7	50.74	43.54	38.73	35.72	42.19
Mean	60.33	53.67	49.54	47.13	
		S.Em ±		CD at 5%	
Treatments (T)		0.21		0.59	
Storage (S)		0.16		0.45	
Interaction (T×S)		0.42		1.19	

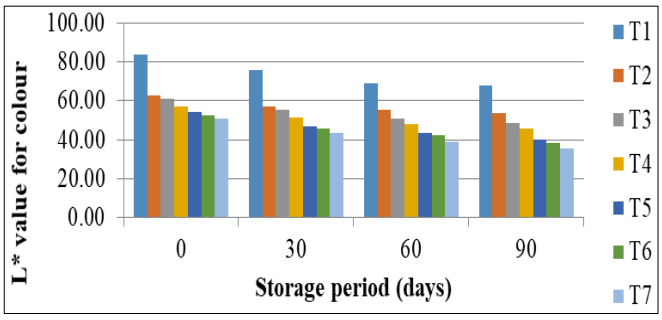

Fig 1: Effect of different proportions of pineapple and kokum juices on L* value for colour of blended jelly during storage

L* value was recorded to determine lightness of jelly which decreased significantly with corresponding decrease in the amount of pineapple juice in the blended jelly.

Highest mean L* value for lightness (73.94) of jelly was found in the treatment T_1 [pineapple (100%): kokum (0%)] which was significantly superior to all other treatments, followed by the treatments T_2 [pineapple (90%): kokum (10%)], T_3 [pineapple (80%): kokum (20%)] and T_4 [pineapple (70%): kokum (30%)]. The lowest mean L* value (42.19) was observed in the treatment T_7 [pineapple (0%): kokum (100%)], followed by the treatmentsT_6 [pineapple (50%): kokum (50%)] and T_5 [pineapple (60%): kokum (40%)]. Similar observations were recorded in sapota and beetroot blended jelly by Gaikwad (2016) and in blackberry jelly by Aleman *et al*. (2011) [2].

A significant decrease was recorded for mean L* values of jelly cubes during the storage period of 90 days. It was decreased from 60.33 to 47.13 up to 90 days of storage. Thus, it can be concluded that darkness of the colour in jelly cubes increased with increase in the storage period. It might be due to change in colour of pineapple from yellow to reddish yellow due to phenolic and non-enzymatic browning during storage. The results in accordance with these findings were reported by Deokar *et al.* (2018) [14] in sapota and tamarind pulp blended jelly.

3.4.1.2 A* value for colour

The data pertaining to a* value for colour of the pineapple – kokum blended jelly during storage are presented in Table 3 and illustrated graphically in Fig 2.

Table 3: Effect of different proportions of pineapple and kokum juices on a* value for colour of blended jelly during storage

Treatments	a* value for colour				Mean
	Storage period (Days)				
	0	30	60	90	
T1	-4.53	-2.34	0.25	0.96	-1.41
T2	19.95	21.33	23.41	25.59	22.57
T3	26.57	30.37	31.63	34.41	30.74
T4	28.31	32.45	34.91	37.11	33.19
T5	29.44	34.97	36.37	42.63	35.85
T6	30.55	35.71	39.25	43.64	37.29
T7	32.41	36.88	40.17	44.94	38.60
Mean	23.24	27.05	29.43	32.75	
		S.Em ±		CD at 5%	
Treatments (T)		0.18		0.50	
Storage (S)		0.13		0.38	
Interaction (T×S)		0.35		1.00	

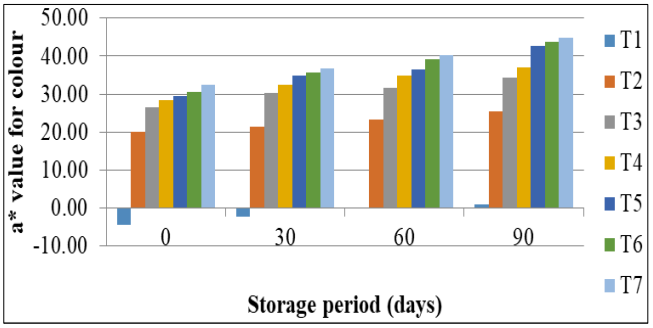

Fig 2: Effect of different proportions of pineapple and kokum juices on a* value for colour of blended jelly during storage

The redness of the blended jelly was determined from a* value for colour of jelly. The present data explicit that the redness of pineapple – kokum blended jelly changed significantly due to the treatments as well as storage period.

Maximum mean a* value for colour (38.60) of jelly was observed in the treatment T_7 [pineapple (0%): kokum (100%)], followed by the treatments T_6 [pineapple (50%): kokum (50%)], T_5 [pineapple (60%): kokum (40%)] and T_4 [pineapple (70%): kokum (30%)]. Minimum mean a* value for colour (-1.41) of the jelly was observed in the treatmentT_1 [pineapple (100%): kokum (0%)]. followed by the treatments T_2 [pineapple (90%): kokum (10%)] andT_3 [pineapple (80%): kokum (20%)]. It is observed from the data that redness of jelly cubes increased due to increase in the level of kokum juice in the blended jelly which was rich in red anthocyanin pigments. Similar result was recorded by Gaikwad (2016) in sapota and beetroot blended jelly and Deokar *et al.* (2018) [14] in sapota and tamarind blended jelly cubes for a* value of colour.

Data on a* value for colour revealed that the redness of jelly increased significantly during storage period of 90 days. At the time of preparation, mean a* value for colour was 23.24 which was increased significantly to 32.75 at 90 days of storage period. Redness of jelly increased due to some browning reaction during storage. Similar findings for a* value were recorded by Moura *et al.* (2011) [24] in strawberry jelly and Raut (2015) [32] in pomegranate and sapota juice blended jelly.

3.4.1.3 B* value for colour

The data related to the b* value for colour of pineapple – kokum blended jelly during storage are presented in Table 4 and illustrated in Fig 3**.**

Table 4: Effect of different proportions of pineapple and kokum juices on b* value for colour of blended jelly during storage:

Treatments	b* value for colour				Mean
	Storage period (Days)				
	0	30	60	90	
T1	43.32	40.55	36.55	30.70	37.78
T2	29.98	28.60	26.84	25.93	27.84
T3	28.19	26.70	25.57	22.54	25.75
T4	24.05	22.76	21.45	20.00	22.06
T5	22.49	20.38	18.13	16.89	19.47
T6	19.70	18.11	16.93	15.42	17.54
T7	17.27	12.87	10.16	8.78	12.27
Mean	26.42	24.28	22.23	20.04	
		S.Em ±		CD at 5%	
Treatments (T)		0.12		0.35	
Storage (S)		0.09		0.27	
Interaction (T×S)		0.25		0.70	

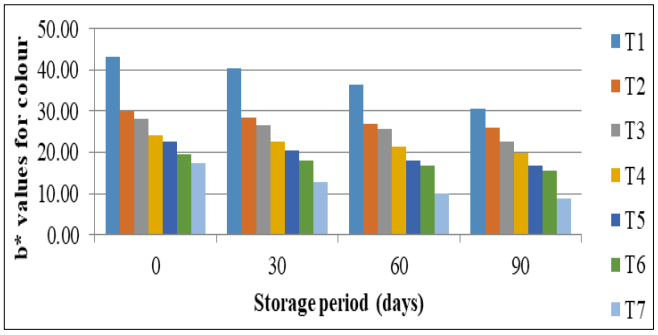

Fig 3: Effect of different proportions of pineapple and kokum juices on b* value for colour of blended jelly during storage

Yellowness of jelly was determined from b* value for colour. The present data indicated that the yellowness of pineapple – kokum blended jelly changed significantly due to the treatments as well as storage period. Maximum mean b* value for colour (37.78) was recorded in the treatment T_1 [pineapple (100%): kokum (0%)] which was significantly superior to all other treatments, followed by the treatments T_2 [pineapple (90%): kokum (10%)] T_3 [pineapple (80%): kokum (20%)] and T_4 [pineapple (70%): kokum (30%)]. Minimum mean b* value for colour (12.27) was recorded in the treatment T_7 [pineapple (0%): kokum (100%)], followed by the treatments T_6 [pineapple (50%): kokum (50%)] andT_5 [pineapple (60%): kokum (40%)]. It is clear from the data that the b* value for colour decreased with corresponding decrease in the proportion of pineapple juice in the blended jelly. Similar result was observed by Gaikwad (2016) in sapota and beetroot blended jelly and Deokar *et al.* (2018) [14] in sapota and tamarind blended jelly cubes for b* value of colour.

A continuous decreasing trend with significant differences was observed in mean b* value for colour during storage. It was 26.42 at the time of preparation which decreased to 20.04 at 90 days of storage. The observation in accordance with this finding was recorded by Gaikwad (2016) in sapota and beetroot blended jelly for b* value of colour.

3.5 Changes in the sensory quality parameters of the pineapple – kokum blended jelly during storage

3.5.1 Colour

The data pertaining to the changes in the sensory score for colour of pineapple – kokum blended jelly during storage are presented in Table 5 and illustrated in the Fig 4. It is evident from the data that the sensory score for colour of the pineapple – kokum blended jelly varied significantly due to the treatments as well as storage period.

Maximum (8.29) mean score for colour of jelly was observed in the treatment T_5 [pineapple (60%): kokum (40%)] which was at par with the treatmentsT_1 [pineapple (100%): kokum (0%)], T_6 [pineapple (50%): kokum (50%)] and T_7 [pineapple (0%): kokum (100%)]. Minimum (7.17) mean score for colour of jelly was obtained by the treatmentT_2 [pineapple (90%): kokum (10%)], followed by the treatmentsT_3 [pineapple (80%): kokum (20%)] and T_4 [pineapple (70%): kokum (30%)], which were at par with each other. Thus, it is clear from the data that the sensory score for colour of blended jelly increased with increase in the proportion of kokum juice in the jelly which imparted attractive red colour to the product. Singh and Chandra (2012) [8] observed similar results in the guava-carrot blended jelly.

The mean sensory score for colour varied significantly during storage period of 90 days. It was highest (8.35) at the time of preparation and lowest (7.40) at90 days of storage. It

Table 5: Effect of different proportions of pineapple and kokum juices on sensory score for colour of blended jelly during storage:

Treatments	Sensory score for colour				Mean
	Storage period (Days)				
	0	30	60	90	
T1	8.67	8.33	7.83	7.67	8.13
T2	7.50	7.33	7.00	6.83	7.17
T3	7.83	8.00	7.33	7.00	7.54
T4	8.50	8.17	7.67	7.17	7.88
T5	8.83	8.33	8.17	7.83	8.29
T6	8.67	8.17	8.00	7.67	8.13
T7	8.50	8.17	7.83	7.67	8.04
Mean	8.35	8.07	7.69	7.40	
		S.Em ±		CD at 5%	

Treatments (T)	0.13	0.36
Storage (S)	0.10	0.27
Interaction (T×S)	0.26	NS

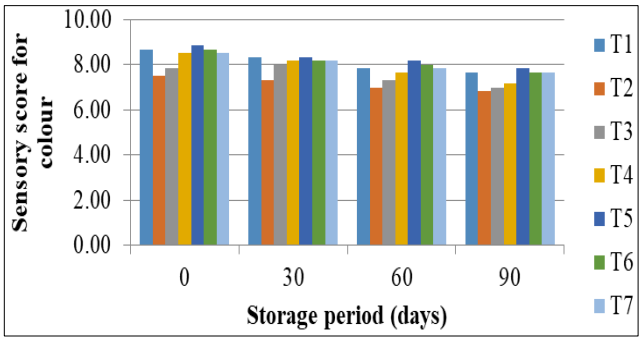

Fig 4: Effect of different proportions of pineapple and kokum juices on sensory score for colour of blended jelly during storage

Is revealed from the data that the likeness for colour of jelly decreased during storage period of 90 days. It might be due to the darkening of the jelly because of browning reactions during storage. Similar trend of decrease in sensory score for colour was observed by Raut (2015) [32] in pomegranate and sapota juice blended jelly and Deokar *et al.* (2018) [14] in sapota and tamarind blended jelly cubes.

3.5.2 Flavour

The data related to the sensory score for flavour of pineapple – kokum blended jelly during storage are presented in Table 6 and graphically illustrated in the Fig 5.

It is apparent from the results that the mean sensory score for flavour was varied significantly due to the treatments and storage period. Maximum mean score for flavour (8.29) of the blended jelly was obtained by the treatment T_5 [pineapple (60%): kokum (40%)] which was at par with the treatmentsT_1 [pineapple (100%): kokum (0%)] and T_4 [pineapple (70%): kokum (30%)]. The treatmentT_3 [pineapple (80%): kokum (20%)] showed minimum (7.33) mean score for flavour which was at par with the treatmentsT_2 [pineapple (90%): kokum (10%)], T_6 [pineapple (50%): kokum (50%)] and T_7 [pineapple (0%): kokum (100%)]. This clearly indicates that kokum juice level upto 40 per cent improved the flavour of pineapple – kokum blended jelly due to optimum sugar: acid blend in the blended jelly cubes.

Table 6: Effect of different proportions of pineapple and kokum juices on sensory score for flavour of blended jelly during storage

Treatments	Sensory score for flavour				Mean
	Storage period (Days)				
	0	30	60	90	
T1	8.67	8.17	7.67	7.50	8.00
T2	8.00	7.67	7.33	7.17	7.54
T3	7.83	7.50	7.17	6.83	7.33
T4	8.50	8.33	8.00	7.50	8.08
T5	8.83	8.50	8.17	7.67	8.29
T6	8.17	8.00	7.67	7.33	7.79
T7	7.83	7.67	7.33	7.00	7.46
Mean	8.26	7.97	7.61	7.28	
		S.Em ±		CD at 5%	
Treatments (T)		0.11		0.32	
Storage (S)		0.09		0.24	
Interaction (T×S)		0.23		NS	

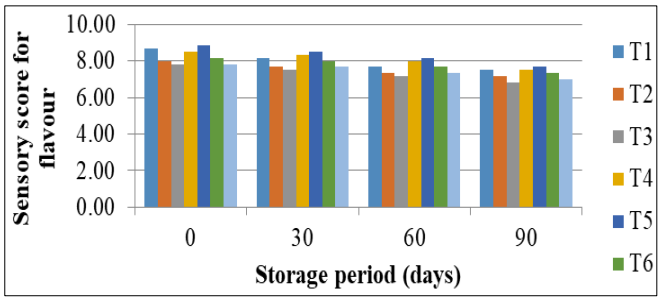

Fig 5: Effect of different proportions of pineapple and kokum juices on sensory score for flavour of blended jelly during storage

As regards storage, the mean score for flavour of the blended jelly was decreased significantly during 90 days of storage. It was maximum (8.26) at the time of preparation which decreased to7.28 at 90 days of storage. This indicates that as the storage period increased, the flavour of blended jelly declined. Singh and Chandra (2012) [8] recorded similar results for flavour of guava-carrot jelly.

3.5.3 Texture

The data related to the changes in sensory score for texture of pineapple – kokum blended jelly during storage are presented in Table 7 and depicted graphically in Fig 6.

Maximum (8.46) mean score for texture of jelly was observed in the treatment T_5 [pineapple (60%): kokum (40%)] which was significantly superior to rest of the treatments. The treatments T_2 [pineapple (90%): kokum (10%)], T_3 [pineapple (80%): kokum (20%)] and T_4 [pineapple (70%): kokum (30%)] were at par with each other. Minimum (6.96) mean score for texture of jelly was obtained by the treatment T_7 [pineapple (0%): kokum (100%)]. The treatment T_3 [pineapple (80%): kokum (20%)] was at par with the treatmentT_6 [pineapple (50%): kokum (50%)]. Thus, it is clear from the data that the sensory score for texture of blended jelly decreased with increase in the proportion of kokum juice in the jelly. This could be due to poor jelly setting owing to higher acidity levels when kokum juice proportion increased beyond 40 per cent in the blended jelly. Singh and Chandra (2012) [8] observed similar results in the guava-carrot blended jelly.

Table 7: Effect of different proportions of pineapple and kokum juices on sensory score for texture of blended jelly during storage

Treatments	Sensory score for texture				Mean
	Storage period (Days)				
	0	30	60	90	
T1	8.83	8.33	8.00	7.83	8.25
T2	8.67	8.17	7.83	7.67	8.08
T3	8.50	7.83	7.67	7.33	7.83
T4	8.67	8.00	7.83	7.67	8.04
T5	9.00	8.67	8.17	8.00	8.46
T6	7.83	7.50	7.50	7.17	7.50
T7	7.67	7.00	6.67	6.50	6.96
Mean	8.45	7.92	7.66	7.45	
		S.Em ±		CD at 5%	
Treatments (T)		0.10		0.29	
Storage (S)		0.08		0.22	
Interaction (T×S)		0.21		NS	

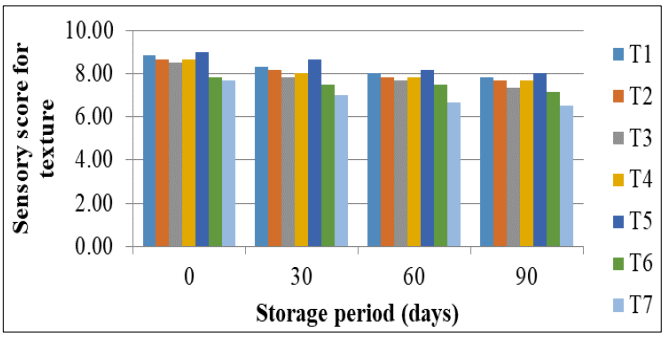

Fig 6: Effect of different proportions of pineapple and kokum juices on sensory score for texture of blended jelly during storage

The statistical analysis of sensory score for texture of pineapple – kokum blended jelly reveals that there was significant difference in mean score for texture during 90 days of storage period. The mean score for texture of the blended jelly was decreased significantly with increase in the storage period. Maximum mean score for texture (8.45) was obtained at the time of preparation which was decreased to 7.45 at 90 days of storage period. This indicates that as the storage period prolonged the textural quality of pineapple – kokum blended jelly declined. Singh and Chandra (2012) [8] recorded similar trend for sensory score for texture of guava and carrot jelly.

3.5.4 Overall acceptability

The data on the changes in the sensory score for overall acceptability of pineapple – kokum blended jelly during storage period are presented in Table 8 and illustrated graphically in the Fig 7.

Maximum (8.35) mean score for overall acceptability of jelly was observed in the treatment T_5 [pineapple (60%): kokum (40%)], followed by the treatments T_1 [pineapple (100%): kokum (0%)] and T_4 [pineapple (70%): kokum (30%)].Minimum (7.49) mean score for overall acceptability of jelly was obtained by the treatment T_7 [pineapple (0%): kokum (100%)].

Table 8: Effect of different proportions of pineapple and kokum juices on sensory score for overall acceptability of blended jelly during storage

Treatments	Sensory score overall acceptability				Mean
	Storage period (Days)				
	0	30	60	90	
T1	8.72	8.28	7.83	7.67	8.13
T2	8.06	7.72	7.39	7.22	7.60
T3	8.06	7.78	7.39	7.06	7.57
T4	8.56	8.17	7.83	7.44	8.00
T5	8.89	8.50	8.17	7.83	8.35
T6	8.22	7.89	7.72	7.39	7.81
T7	8.00	7.61	7.28	7.06	7.49
Mean	8.35	7.99	7.65	7.38	
		S.Em ±		CD at 5%	
Treatments (T)		0.10		0.27	
Storage (S)		0.07		0.21	
Interaction (T×S)		0.19		NS	

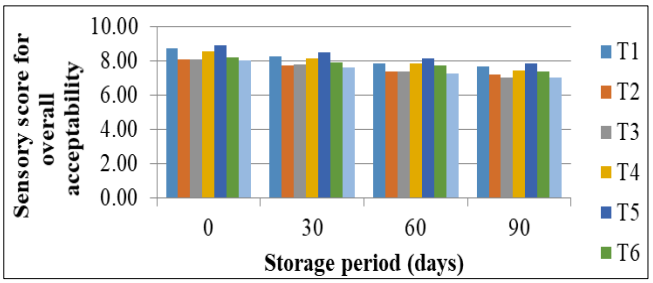

Fig 7: Effect of different proportions of pineapple and kokum juices on sensory score for overall acceptability of blended jelly during storage

The treatmentsT_2 [pineapple (90%): kokum (10%)], T_3 [pineapple (80%): kokum (20%)] and treatmentT_6 [pineapple (50%): kokum (50%)] were at par with each other Thus, it is clear from the data that the sensory score for overall acceptability of blended jelly increased with increase in the kokum juice level in the jelly upto 40 per cent. However, the overall acceptability of the product was reduced significantly when the kokum juice level increased to 50 per cent. Moreover, the sensory quality of straight kokum jelly (100% kokum juice) was very poor as compared to straight pineapple jelly or other blended ratios. As far as overall acceptability is concerned, the kokum juice level@ 40 per cent was the optimum for the preparation of pineapple – kokum blended jelly. Singh and Chandra (2012) [8] observed similar results in the guava-carrot blended jelly.

Significant differences were observed in the mean sensory score for overall acceptability of pineapple – kokum blended jelly during at 90 days of storage period. The mean sensory score for overall acceptability of the blended jelly was decreased significantly with increase in the storage period. Maximum mean score for overall acceptability of 8.35 was obtained at the time of preparation which was decreased to 7.38 at 90 days of storage period. Singh and Chandra (2012) [8] recorded similar trend for sensory score for overall acceptability of guava and carrot jelly.

4. Economics of pineapple – kokum blended jelly

The total cost of production of 100 kg jelly was maximum (Rs. 39142.16) in the treatment T_1 [pineapple (100%): kokum (0%)], followed by the treatmentT_2 [pineapple (90%): kokum (10%)]. It might be due to higher quantity of costlier pineapple juice required for the preparation of the jelly. The lowest (Rs.37841.06) cost of production of 100 kg jelly was observed in the treatment T_7 [pineapple (0%): kokum (100%)]. It is clear from the economics of 100 kg jelly production that increasing the proportions of pineapple juices in the jelly increased the total cost of production of the pineapple – kokum blended jelly. The sale price of the pineapple – kokum blended jelly was considered as 600/- per kg.

Highest net profit (Rs. 22158.94) was observed in the treatment T_7 [pineapple (0%): kokum (100%)] while it was the lowest (Rs.20857.84) in the treatmentT_1 [pineapple (100%): kokum (0%)].

The net profit of Rs 21694.49 was observed in the best rated treatment i.e. T_5 [pineapple (60%): kokum (40%)]. The maximum (1.58) B: C ratio was observed in the treatment T_7 [pineapple (0%): kokum (100%)] where as it was the minimum (1.53) in the treatment T_1 [pineapple (100%): kokum (0%)]. The B: C ratio increased with increasing kokum juice level in the blended jelly.

5. Conclusion

It was observed from the data that the pineapple – kokum blended jelly irrespective of juice properties were acceptable during three months of storage at ambient conditions. Blending of pineapple and kokum juice improved physical and sensory quality characteristics like colour, flavor, etc. of the jelly. The sensory evaluation of jelly revealed that the colour, flavour and firmness of the jelly retained up to 90 days of storage period at ambient conditions. Blending of pineapple with kokum juice improved colour and flavour of the blended jelly. Based on the organoleptic evaluation and economics of the jelly, it is concluded that the pineapple – kokum blended jelly could be prepared successfully by blending 60 per cent pineapple and 40 per cent kokum juice.

6. Acknowledgement

I extend my sincere thanks to Dr. Pradip P. Relekar (Guide/Chairman) and to my advisory committee members for giving me proper guidance throughout the course of study. I also sincerely thank PGI-PHM, Killa-Roha (Dr. Balasaheb Sawant Konkan Krishi Vidhyapeeth, Dapoli) for supporting the research financially.

Plate 1: Pineapple - kokum blended jelly during 0 day of storage

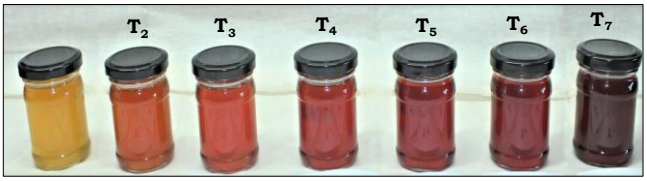

Plate 2: Pineapple - kokum blended jelly during 30 days of storage

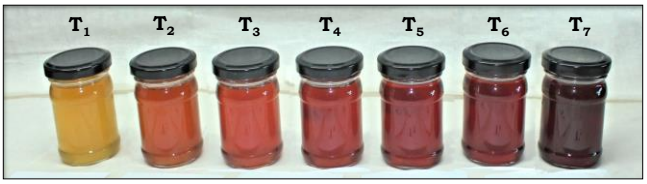

Plate 3: Pineapple - kokum blended jelly during 60 days of storage

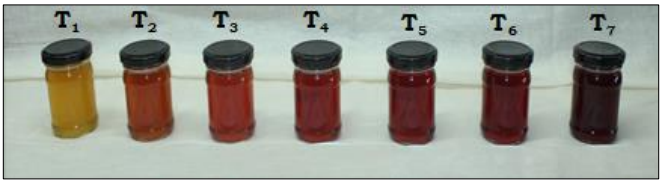

Plate 4: Pineapple - kokum blended jelly during 90 days of storage

7. References

1. AOAC. Official methods of analysis. Association of official analytical chemists, Washington DC, USA; c1975.
2. Aleman S, Pacheco-Delahaye E, Perez E, Schroeder M. Elaboration of blackberry (*Rubus glaucus* Benth) jellies with native and modified banana starches (*Musa* ABB). African J. Fd. Sci. 2011 Apr 30;5(4):181-187.
3. Amdekar SJ. In: Statistical Method for Agricultural and Biological Sciences. Narosa Publishing House Private Limited. New Delhi; c2014.
4. Amerine MA, Pangborn RM, Roessler EB. Principles of sensory evaluation of food. Elsevier; c1965.
5. Anonymous. A report published from Indian horticulture database (NHB); c2017[a].
6. Anonymous. India agristat. Area and production of pineapple; c2017b. http:// www. indiaagristat.com
7. Anonymous. International tropical fruit network; c2018.
8. Asgekar MA. Studies on physico-chemical composition, some aspects of post-harvest handling and processing of pineapple (*Ananas comosus* L.) cv. Kew fruits. A M.Sc (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.); c2002.
9. Assawarachan R, Noomhorm A. Changes in colour and rheological behaviour of pineapple concentrate through various evaporation methods. International journal of agricultural and biological engineering. 2010;3(1):74-84.
10. Balaswamy K, Prabhakara Rao PG, Nagender A, Narsing Rao G, Sathiya Mala K, Jyothirmayi T, Satyanarayana A. Development of smoothies from selected fruit pulps/ juices. International Food Research Journal. 2013 Jul 1;20(3):1181-1185.
11. Chavan BD. Studies on blending, carbonation and storage of fruit based beverages of Cashewapple (*Anacardium occidentale* Linn.), Karonda (*Carrisa carandas* L.), Kokum (*Garcinia indica* choisy) and Lime (*Citrus aurentifolia* L.) fruits. A M.Sc. (Agri.) Thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.); c1997.
12. Coveca. Veracruz commission of agricultural marketing. Gobierno del Estado de Veracruz, México; c2002.
13. Dalvi RB. Studies on carbonation of fruit based beverages. A M.Sc (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.); c1998.
14. Deokar VT, Pujari KH, Relekar PP. Development of Blended Sapota [*Manilkara achras* (Mill) Fosberg] and Tamarind (*Tamarindus indica* L.) Jelly Cubes. International Journal of Current Microbiology and Applied Sciences. 2018;7(2):456-467.
15. Expedito ST, Rahman MS, Buckle KA. Osmotic dehydration of pineapple: kinetics and product quality. Food Research International. 1996;29(3-4):227-233.
16. Hossain MF, Akhtar S, Anwar M. Nutritional value and medicinal benefits of pineapple. International Journal of Nutrition and Food Sciences. 2015 Jan;4(1):84.
17. Joshi AB. Studies on some aspects of post-harvest handling and processing of kokum (*Garcinia indica* Choisy) fruits. A M.sc. (Agri) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.); c1994.
18. Khalid N, Suleria HAR, Ahmed I. Pineapple juice. Handbook of Functional Beverages and Human Health. 2016;1:489-98.
19. Khurdiya DS. Processing and Preservation of pineapple

products. Beverage and Food World. 1987;14(1):51-52.
20. Kiiyukia C. Laboratory manual of food microbiology for Ethiopian health and nutrition research institute. UNIDO project (YA/ETH/03/436/11-52); c2003. p. 1-197.
21. Krishnamurthy N, Lewis YS, Ravindranatha B. Chemical constitution of Kokum fruit-rind. Journal of Food Science and Technology. 1982;19:97-100.
22. Lane JH, Eynon L. Methods for determination of reducing and no reducing sugars. Journal of Science. 1923;42:32-37.
23. Marathe AV. Studies on unfermented beverages from cashew (*Anacardium occidentale L.*) apple. A M.Sc. (Agri.) thesis submitted to the Konkan Krishi Vidyapeeth, Dapoli, Dist: Ratnagiri (M.S.); c1989.
24. Moura SCSR, Prat P, Vissotto FZ, Rita CSCO, Marina S. R. Colour degradation kinetics in low-calorie strawberry and guava jellies. Cienc. Tecnol. Aliment. 2011;31(3):758-764.
25. Nair GR. Studies on maturity indices and post-harvest technology of kokum (*Garcinia indica* choisy). A. M.Sc. (Agri.) Thesis submitted to Dr. BSKKV, Dapoli, Dist Ratnagiri. (M.S.); c1986.
26. Nanjundaswamy AM. Economic utilization of cashew apple. Cashew causerie. 1984;6(2):2-7.
27. Nayak CA, Rastogi NK, Raghavarao KSMS. Bioactive constituents present in Garcinia indica Choisy and its potential food applications: A review. International Journal of Food Properties. 2010 Apr 30;13(3):441-453.
28. Padhye S, Ahmad A, Oswal N, Sarkar FH. Emerging role of Garcinol, the antioxidant chalcone from *Garcinia indica* Choisy and its synthetic analogs. Journal of Hematology and Oncology. 2009;2(38):1-13.
29. Panse VG, Sukhatme PVE. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India; c1985.
30. Patil BP, Gawankar MS, Sagvekar VV, N Jambhale, ND. Status of existing kokum plantation in Maharashtra. Proceedings of the second national seminar on Kokum held at Goa University, Taleigao Goa on 4-5th; c2005 March, p. 17-19
31. Ranganna S. Handbook of analysis and quality control for fruits and vegetable products. Tata McGraw-Hill Publishing Company Limited. New Delhi; c2003.
32. Raut PS. Studies on preparation of pomegranate (*Punica granatum* L.): sapota (*Manilkara achras* (Mill.) Fosberg) blended jelly. M.Sc. (Post-harvest management) thesis submitted to the Post Graduate Institute of Post-Harvest Management, Killa-Roha, Dist. Raigad, Maharashtra (India); c2015.
33. Relekar PP, Naik AG, Padhiar BV. Qualitative changes in value added products of sapota Cv. kalipatti during storage. Indian J. Hort. 2011;68(3):431-418.
34. Saad S. The world pineapple market; when growth goes hand in hand with diversity. 2004. http//:www.tanusi.com
35. Samson JA. Tropical Fruits. Longman Incorporated Publishers, New York; c1986. p. 44-56.
36. Sawant DS, Rajput JC, Magdum MB, Dumbre RB. Release proposal for kokum Amruta by K.K.V., Dapoli, Ratnagiri, M.S; c1997.
37. Shingare DV, Gawankar MS, Patil BP, Sagavekar VV, Wadakar SS. Economic Evaluation of Rainfed Aonla cultivation in Konkan region of Maharashtra: Indian Journal of Agricultural Marketing. 2005;19(1):73-78.
38. Singh J, Chandra S. Preparation and evaluation of guava-carrot jelly Int. J. FD. Ferment. Technnol, 2012 Dec 1;2(2):197-200.
39. Singh K, Mishra S, Prasad VM. Effect of different ratio of pineapple and apple pulp on quality and shelf life of blended cheese. IJCS. 2017;5(4):1212-1216.
40. Tochi BN, Wang Z, Xu SY, Zhang W. Therapeutic application of pineapple protease (bromelain): A review. Pakistan journal of nutrition. 2008;7(4):513-520.