"STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.): POMEGRANATE (*Punica granatum*) RTS"

By

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B.Sc. (Agri.)

DEPARTMENT OF POST HARVEST MANAGEMENT OF FRUIT, VEGETABLE AND FLOWER CROPS

FACULTY OF POST HARVEST MANAGEMENT,

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July, 2016

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A thesis submitted to the

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH, DAPOLI
(Agricultural University)
Dist. Ratnagiri
(Maharashtra State)

in partial fulfillment of the requirements for the degree of

Master of Science

(Post Harvest Management)

in

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CERTIFICATE

This is to certify that the thesis entitled **" STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.): POMEGRANATE (*Punica granatum*.) RTS"** *submitted to the Faculty of Post Harvest Management, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, (Maharashtra State), in the partial fulfilment of the requirements for the degree of* **MASTER OF SCIENCE (POST HARVEST MANAGEMENT)** *in* **FRUIT, VEGETABLE AND FLOWER CROPS**, *embodies the results of a piece of bona-fide research carried out by* **Mr. ANIKET EKNATH GAIKWAD** *under my guidance and supervision. No part of this thesis has been submitted for any other degree or diploma. All the assistance and help received during the course of investigation and the sources of literature have been duly acknowledged by him.*

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CANDIDATE'S DECLARATION

I hereby declare that the thesis or any part thereof has not been previously submitted by me or other person to any other University or Institute for a degree

ACKNOWLEDGEMENT

At this gratifying moment of completion of my research problem, I feel obliged to record my gratitude to those who have helped me. First of all I express my infinite indebtedness and deep sense of gratitude to the God for continuously providing my spiritual energy, which has inspired me to reach at the highest excellence.

Some moments in life are cherished forever for one reason or another and this one is not exception for me. It is a moment of great pleasure in recording my fervent sence of gratitude.

Indeed the words at my command are not adequate to convey the depth of my feeling and gratitude to my honorable research guide, ***Dr. P. P. Relekar,*** *Associate Professor, Post Graduate Institute Of Post Harvest Management, Killa-Roha, District Raigad for his most valuable and inspiring guidance with his friendly nature, love and affection, for his attention and magnanimous attitude right from the first day, constant encouragement, enormous help and constructive criticism throughout the course of this investigation and preparation of this manuscript.*

I place on record my coordinal thanks to Hon. ***Dr. T. Bhattacharaya,*** *Vice Chancellor, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. I feel a great pleasure in getting this proud privilege offering my sincerest and devoted thanks to* ***Dr. K. H. Pujari,*** *Associate Dean, Post Graduate Institute Of Post Harvest Management, Killa-Roha, District Raigad. For their valuable guidance and co-operation throughout the course of my studies and other members of my advisory committee* ***Dr. N. B. Gokhale,*** *Incharge of Plant Biotechnology, for his help in analytical research study for their worthy suggestions, ever willing help and unbiased attitude throughout the course of this investigation.*

My profound and sincere thanks to all staff members viz. ***Mr. Khapare Sir, Mr. Debaje sir*** *from the Dept. of Post Harvest management of Fruit, Vegetable and flower crops, Post Harvest Institute of Post Harvest Management and Central Library, Konkan Krishi Vidyapeeth for their valuable guidance and co-operation throughout the course of my studies.*

I acknowledge with thanks for the facilities provided by the Director of Research, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli and the Dean, College of Agriculture, Dapoli during the course of my studies

The word like thanks should not come in between friends, but it came from the bottom of heart for my beloved, sweet friends ***Sidhesh, Tejashree, Anmol, Shivam*** *,* ***Shobha, Ajinkya,*** *Pranaykumar, Hitendra, Prashant, Ganesh and other colleagues for their helping and kind co-operation during the course of study.*

It is friends who share your secret, who provides crutches to crumbling house of confidence and remembrance. I am greatful to god for giving me friends like Shivam, Anmol, Nitin, Nitesh, Durgesh and my dear brother Mr. Swapnil Eknath Gaikwad and my dear sister Ms. Pradnya Ravi Shirsath for their kind co-operation and companionship.

No word could do justice to express my sence of respect and gratitude to word my beloved Parents and all my lovely family members for their everlasting love, constant encouragement, prayer support and sacrifice, without which this dream could not have become a reality.

Last, but far from the least, I wish to express my deepest gratitude and sole full respect to 'God', who helped me on every path of life and made every step a great success.

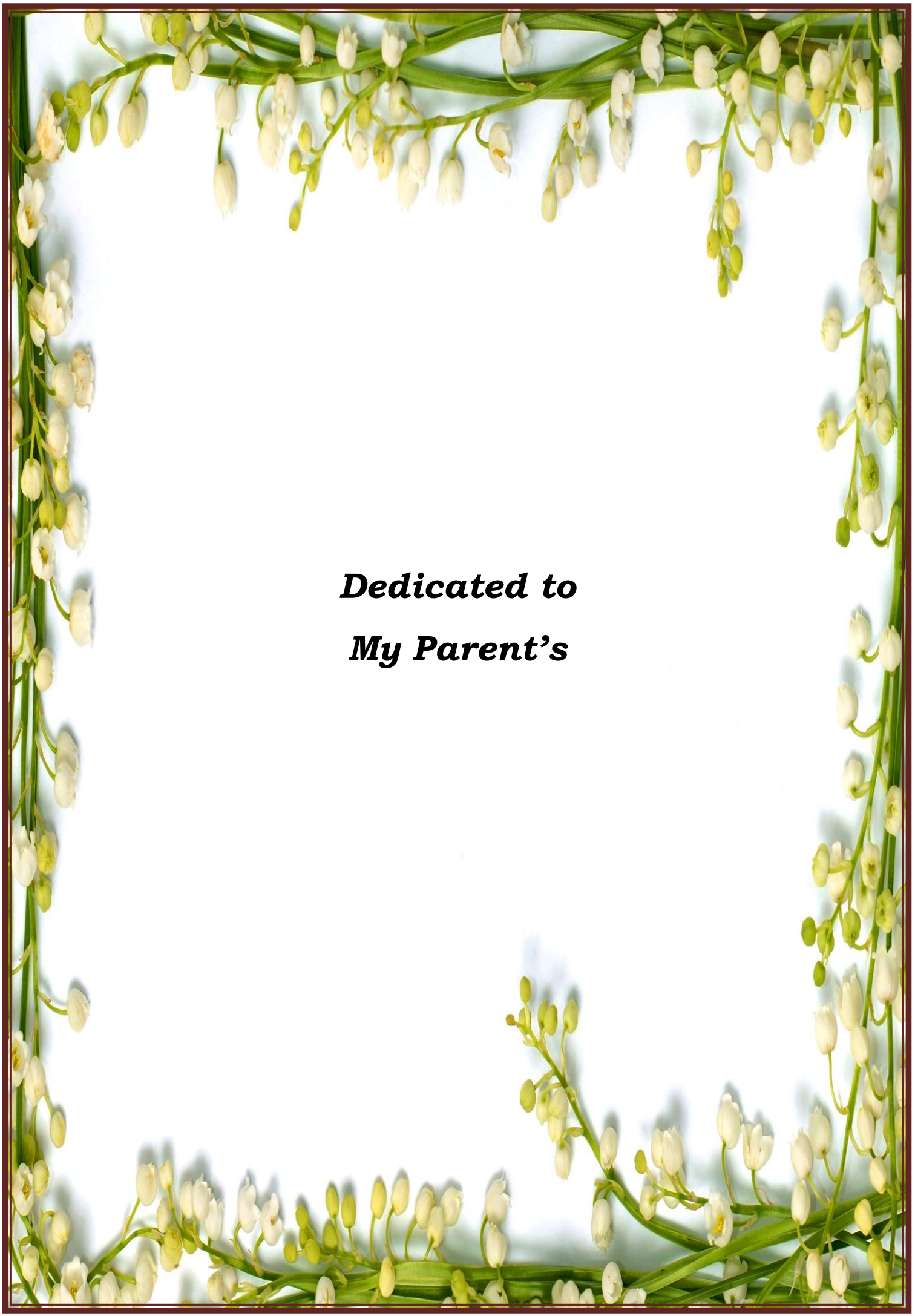
Place*: Killa-Roha*

Date*: / / 2016*

(Gaikwad Aniket Eknath)

Place: Roha-killa **(A. E. GAIKWAD.)**

Date: / / 2016



Dedicated to

My Parent's

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VITAE

ANIKET EKNATH GAIKWAD.

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DEPARTMENT OF POST HARVEST MANAGEMENT OF FRUIT, VEGETABLE AND FLOWER CROPS

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DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH, DAPOLI

Title of thesis	**:**	Studies on preparation of blended pineapple (*Ananas comosus* L.) :pomegranate (*Punica granatum*) RTS.
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Regd. No	**:**	PHMRM-140093
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ABSTRACT

The present research work entitled “Studies on preparation of blended pineapple (*Ananas comosus* L.) pomegranate (*Punica granatum*) RTS” was undertaken in the Department of Post-Harvest Management of Fruit, Vegetable and Flower crops in Post Graduate Institute of Post-Harvest Management, Killa-Roha, during the year 2015-2016.

The experiment on preparation of pineapple: pomegranate blended RTS was laid out with five main treatments, four sub treatments with three replications. The experiment was conducted by using factorial completely randomized design (FCRD) and the product was analyzed for physico-chemical composition and sensory

qualities at an interval of 30 days till 90 days of storage period at ambient conditions.

The present study revealed that the physical parameters viz. L* value for colour decreased with increasing a* and b* value for colour during the storage period of 90 days. The chemical parameters viz. T.S.S., reducing sugars, acidity and total sugars increased during storage period of 90 days.

Among all the RTS recipes i.e. 60:40 (pineapple: pomegranate) was found to be the best recipe for blended RTS with highest organoleptic score for colour, flavour and overall acceptability and higher gross returns on the investment.

APPENDIX I

Weekly Weather Data, Roha Center (Year 2015-16)

Period	Ambient storage conditions			
	Temperature (ºC)		Relative humidity (%)	
	Max.	Min.	Max.	Min.
02.11 - 08.11	37.0	21.5	60.4	32
09.11 - 15.11	34.1	25.0	84.0	51
16.11 - 22.11	34.8	24.2	89.4	52
23.11 - 29.11	33.5	16.2	88.3	41
07.12 - 13.12	33.4	18.2	78.0	58
14.12 - 20.12	29.8	14.3	88.4	54
21.12 - 27.12	32.9	16.9	94.0	62
28.12 - 03.01	26.6	12.4	55.0	22
04.01 - 10.01	27.7	14.4	88.0	42
11.01 - 17.01	25.3	13.4	77.0	32
18.01 - 24.01	26.0	11.3	72.4	30
25.01 - 31.01	26.6	11.7	67.7	42
01.02 – 07.02	26.0	11.1	82.6	45
08.02 – 14.02	30.1	13.5	60.4	42
15.02 – 21.02	37.1	17.3	73.4	45
22.02 – 28.02	31.6	16.4	69.3	35
01.03 – 07.03	33.8	25.1	89.1	76
08.03 – 14.03	31.0	23.9	91.4	91
15.03 – 21.03	37.0	17.0	73.0	54
22.03 – 28.03	31.5	16.0	69.0	24
29.03 – 04.04	34.0	19.5	78.0	23

APPENDIX II
ABBREVIATIONS USED

%	:	per cent
/	:	per
@	:	At the rate of
°B	:	Degree Brix
^{0}C	:	Degree Celsius
A.O.A.C	:	Association of Official Analytical
C.D.	:	Critical difference
Cv.	:	Cultivar
et al.	:	and others
etc.	:	et cetera (and so on)
Anon.	:	Anonymous
FAO	:	Food and Agriculture Organization
Fig.	:	Figure
g	:	Gram (s)
ha	:	Hectare
i.e.	:	that is
kg/cm^2	:	Kilogram per square centimeter
KMS	:	Potassium Metabisulphite
mg	:	Milligram
mL	:	Millilitre
S.Em.	:	Standard error of mean
Sig.	:	Significant
NS	:	Non-significant
FCRD	:	Factorial Completely randomized design
LTD.	:	LIMITED
TSS	:	Total soluble solids

ppm	:	Part per million
PL	:	Polyethylene
Pvt.	:	Private
var.	:	Variety

CHAPTER I

INTRODUCTION

India is known for its varied agro climatic conditions which is suitable for cultivation of variety of the fruits in different seasons of the year. The major tropical, subtropical as well as temperate fruit crops are grown simultaneously in different parts of country. Besides major tropical fruits like mango, banana,etc. thepineapple (*Ananas comosus* L.) is one of the commercially important fruit crops grown in India. Pineapple is originated from Central and Southern Brazil, North Argentina and Paraguay (Baker and Collins, 1939). The name pineapple is derived from Spanish word 'Pina', based on appearance of its fruits, which resemblesa pine cone as well as the name of genus, *Ananas* is derived from the Tupi-Guarani Indian word 'Nana'.

Pineapple fruits have characteristics pleasant, flavour, distinct aroma, exquisite taste and absence of seeds which qualifies it as one of the choicest fruits throughout the world. It is a good source of carotene and ascorbic acids and is fairly rich in vitamin B and vitamin B2. It also contains phosphorus and minerals like calcium, magnesium, potassium and iron (Rashmi *et al.*,2005).The hundred grams of pineapple pulp contains 87.3 g water, 0.54 g protein, 13.7 g carbohydrates, 16 mg calcium, 11 mg phosphorus, 0.28 mg iron, 1.5 mg, 12 mg magnesium, 130 IU vitamin A, 0.079 mg vitamin B1, 0.031 mg vitamin B2, 24 mg ascorbic acid, and gives 52 calories of energy (Hossain*et al.*, 2015).

The Pineapple producing countries are Philippines, Thailand, China, Brazil, India, Mexico and South Africa. India is the fourth largest producer of pineapple in the world contributing almost 9 per cent to the world production of fresh pineapple (Anon., 2003). The world production of pineapple is 13147 metric tonnes. In India,pineapple is grown on an area of 78200 ha with a production of 12.211 lakh metric tonnes. The major pineapple producing states are Assam (2, 16,100tonnes), West Bengal (2, 79,500 tonnes), Kerala (84,600 tonnes), Meghalaya (81,700 tonnes) and Karnataka (81,193 tonnes)(Rashmi *et al.*,2005).In Maharashtra, pineapple is grown on 400 ha with production of 900 MT (Anon.,2007) and it is mostly grown in the Konkan region due to hot and humid climatic conditions and sloppy land. Nearly 80 per cent of pineapple production found in the market is in processed form, out of which 48 per cent is used for single or concentrated juice and 30 per cent for canned fruits in the world (Saad, 2004).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.

Processed pineapples are consumed worldwide and processing industries are trying out or using new technologies to retain the nutritional quality of the pineapple fruit. This is to meet the demand of consumers who want healthy, nutritious and natural products with high organoleptic qualities.

Pomegranate (*Punica granatum* L.) belongs to the family punicaceae and is one of the favorite table fruits of many tropical and sub-tropical regions of the world having great

processing potential, grown especially in the moderate climates of Mediterranean countries.

Pomegranate is originated from Iran. It is cultivated in Spain, Egypt, Afghanistan, Pakistan, China, Japan, Russia, America and India. The area under this crop is 1, 13,000 hectares with the production of 7, 45,000 MT in the year 2012-13 in India (Anon., 2014). Maharashtra state is the leading producer of pomegranate. The area under this crop is 82,000 ha with the production of 492 MT in the year 2010-11 in Maharashtra (Anon., 2011). In Maharashtra, the pomegranate is cultivated in the districts of Solapur, Nasik, Ahmednagar, Pune, Sangli, Dhule, Latur, Usmanabad, Jalna, Parbhani, Aurangabad, Beed and Satara.

The pomegranate enjoys reputation for its healthy, dietetic and medicinal properties. It has better keeping quality, good market price and a high export potential. In recent years, the area under pomegranate in India has increased substantially, mainly because of its versatile adaptability, drought tolerance and high yields. Maximum yield is obtained when pomegranate is supplemented with irrigation. The area under pomegranate in Maharashtra has been increasing year after year.

The commercially grown pomegranate varieties in Indiaare Ganesh, Bhagwa, Phule Arakta and Mridula. The varieties such as Bhagwa and Arakta have been recommended/released,respectively for cultivation in Maharashtra state by Mahatma Phule Krishi Vidyapith, Rahuri. Among these varieties, Bhagwa variety produces a glossy red coloured fruit with soft seeds and high total soluble solids. The fruits are generally harvested fully ripe

with a waxy skin surface of reddish yellow or greenish red colour, depending on the cultivar.

Pomegranate is not only used for consumption but also used as medicine. According to EL-Nemer *et al;* (1990), the edible portion of pomegranate fruit was 52 per cent of total fruit weight which contained 78 per cent juice and 22 per cent seeds. The fresh juice contained 85.4 per cent moisture, 10.6 per cent total sugars, 1.4 per cent pectin 0.19 per cent total acidity and 19.6 mg free amino nitrogen per 100 ml juice.

Pomegranate is commercially grown for its sweet acidic taste. Fruits are mainly used for dessert purposes. The pomegranate also has wide consumer preference for its attractive, juicy, sweet, acidic and refreshing fruits. The aril portion of fruits is used for fresh consumption as well as in salad and processing. During seasonal glut, the fruit prices are fairly low and due to cracking problem the pomegranate fruits need to be processed and preserved. The pomegranate can be processed into products like juice, carbonated drinks, syrup, jelly, wine, anar-rub, anardana and canned beverages (Dhumal *et al.,* 2014). The pomegranate juice has attractive colour. However, the pomegranate juice has very poor flavour (Nakadi, 1998). Therefore, juice needs to be blended with some other juices having strong flavour and high nutritional value for consumer acceptance.

The blending technology has become an important tool in modern fruit beverage processing to develop new beverages of superior quality having sensory, nutritional and medicinal properties of two or more plant species. The attractive appearance, appealing flavour, nutrients

retention, medicinal values and other organoleptic qualities are the main consideration in standardization of different ratios of blend components which meets the consumers preference and improves the marketability of the new blended products. The ready–to-serve (RTS) beverages are very popular among consumers of all age groups because of its easiness to carry and consume. The RTS is a beverage which contains 10 per cent juice, 10°B TSS and 0.30 percent acidity. The nutritional as well as sensory quality of the RTS could be improved by blending pineapple and pomegranate juice.

Keeping this in view, the present study entitled "Studies on preparation of blended pineapple (*Ananas comosus*): pomegranate (*Punica grantum)* RTS" was undertaken with following objectives.

1) To standardize the recipe of pineapple and pomegranate blended RTS
2) To study the storage behaviour of pineapple pomegranate blended RTS at ambient conditions.

CHAPTER – II
REVIEW OF LITERATURE

The research entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.): pomegranate (*Punica granatum*) RTS" is reviewed in the current chapter under the following headings. Since very limited work has been reported on processing of blended pineapple: pomegranate RTS, the literature in this regard on other important fruit crops is also reviewed.

2.1 Juice recovery of pineapple and pomegranate fruits

2.2 Chemical composition of fresh pineapple and pomegranate

2.3 Preparation of blended RTS

2.4 Physical parameters of blended RTS

2.5 Changes in chemical composition of blended RTS during storage

2.6 Sensory evaluation of blended RTS

2.7 Microbial spoilage

2.1 Juice recovery of pineapple and other fruits

Khurdiya and Roy (1985) studied various methods of jamun juice extraction and found that the juice yield varied according to the method used. Hand crushing and basket pressing reported the minimum juice yield (32%) while steaming (5 min.) and basket pressing yielded 41.8 per cent juice. Different juice recoveries were recorded due to effect of heating, incorporation of water and

enzyme treatments, hand crushing, heating, steaming, pulping, grating and basket pressing.

Sonkar and Ladaniya (1995) reported that the juice yield in nagpur mandarin after 15 days interval ranged from 32 to 42 per cent.

Saxena *et al.* (1996) recorded 57 per cent juice yield in grape (var. Perlette) and 69.2 per cent in mango (var. Langra) extracted by cold pressing method.

Dalvi (1998) reported the juice recovery in kokum, jamun, sapota and pineapple fruits as 29.84, 40.74, 34.34 and 42.01 per cent, respectively.

Asgekar (2002) reported 50.59 per cent juice recovery in pineapple CV. Kew.

Bhatnagar and Chandra (2002) studied the acid lime cv. Kagzi lime in the nine orchards of fruit growers in Rajasthan state and reported that the average fruit juice recovery was ranged from 37.94 to 46.78 per cent.

Dhutade (2012) reported that sapota juice recovery was 40 per cent.

Shikhare (2014) observed that the average juice recovery of sapota fruit was 36.5 per cent.

Chavan (2015) observed 50.30 per cent juice recovery in pineapple fruit.

2.2 Chemical composition of fresh pineapple and pomegranate fruit

2.2.1. Total soluble solids (T.S.S.)

Kumbhar *et al.* (2002) conducted an experiment to study the effect of methods of juice extraction on the quality of pomegranate

wine and observed 14.6 °B total soluble solids by hand press method.

Chatterjee *et al.* (2005) reported maximum TSS (25 %) in Amrapali fruits at ripe stage.

Rashmi *et al.* (2005) observed that the average TSS of pineapple fruits was 14.5˚Brix.

Dhumal *et al.* (2013) worked on the development of pomegranate juice processing technology and observed 14.80 °B total soluble solid contents in pomegranate juice.

Hire (2013) conducted an experiment on preparation of blended pomegranate and cashew apple nectar and recorded 14.4 °B total soluble solid content in pomegranate fruit.

2.2.2. Titratable acidity

Hossain *et al.* (2001) reported highest 0.87 per cent titratable acidity in cv. Bishawanath, followed by 0.79 and 0.60 per cent in Amrapali and Mallika fruits, respectively.

Kumbhar *et al.* (2002) conducted an experiment to study the effect of methods of juice extraction on the quality of pomegranate wine and observed 0.35 per cent titratable acidity in the juice extracted by hand press method.

Rashmi *et al.* (2005) observed that the pineapple had 0.66 percent acidity.

Dhumal *et al.* (2013), while working on the development of pomegranate juice processing technology observed 0.46 per cent titratable acidity in pomegranate juice.

Hire (2013) conducted an experiment on the preparation of blended pomegranate and cashew apple nectar and recorded 0.39 per cent titratable acidity in pomegranate fruit.

2.2.3. Sugars (reducing and total sugars)

Rashmi *et al* (2005) observed that average reducing sugar content in pineapple was 6.44 per cent reducing sugars and 13.76 per cent total sugars.

Dhumal *et al.* (2013), while developing the pomegranate juice processing technology, observed 14.70 per cent reducing sugar content in pomegranate juice.

Hire (2013) conducted an experiment on the preparation of blended pomegranate and cashew apple nectar. They reported 12 per cent reducing sugar content and 13.31 per cent total sugar content in pomegranate fruit.

2.3 Preparation of blended RTS

Hire (2013) prepared blended pomegranate and cashew apple nectar of different proportions (60:40, 70:30, 80:20, 90:10, 100:00, 00:100). Combination of 80:20 proportion of pomegranate and cashew apple was the best for preparation of blended nectar.

Sindumati and Premalata (2013) carried out an experiment to study the feasibility of blending papaya and pineapple in different ratios such as 80:20, 70:30, 60:40, and 50:50, out if which the ratio of 50:50 was reached the highest sensory scores for overall acceptability.

Deen and Kumar (2014) worked on blended RTS of mango and ginger juice. The study revealed that the palatable RTS

beverage with 13˚ B TSS and 0.25 per cent acidity could be prepared using 12 per cent of blend comprising mango pulp and ginger juice in 9:1 ratio. The TSS, acidity, reducing sugars and total sugar content increased, whereas ascorbic acid and non-reducing sugar content decreased during storage.

Bhavya and Vanajalata (2015) prepared blended pomegranate: sweet orange RTS (18% juice, 15˚B RTS and 0.3% acidity). Out of which sweet orange: pomegranate juice ratio of (60:40) was the best proportion for the preparation of blended RTS.

Tiwari and Deen (2015) prepared the RTS beverage from a blend consisting 75 per cent bael pulp and 25 per cent *Aloe vera* gel which was the most acceptable than other blends.

2.3.1 Colour (L*, a* and b* values)

Spayd *et al.* (1984) observed that the black raspberry-apple blends stored at 25^0 C for 48 hours resulted in increased polymeric colour and per cent colour due to increased tannins, while anthocyanin concentration decreased.

Khurdiya (1993) observed that the Amrapali mango nectar possessed 1.22, 6.79 and 1.19 times higher values of L, + a and + b than those of Totapuri, respectively.

Deka (2000) reported a decreasing trend in hunter L* and a* values and increasing trend in b* value and colour differences during storage of lime-aonla and mango-pineapple spiced RTS beverages in different containers under various storage conditions.

Rein and Heinonen (2004) reported the L*, a*, b*, c* and h* values of different juices of berries in studies on stability and enhancement of berry juice colour.

Lee Siew Yoong (2006) reported the colour of diluted calamansi fruit juice was greenish yellow with colour values of L*= 23.1, a*= -1.1, b*= 20.9 and colour of pineapple juice and pineapple beverage was light yellow with 44.44 and 64.62 L* values, 1.14 and 0.53 a* values and 25.43 and 25.90 b* values, respectively. They also reported that the star fruit juice was dark yellowish orange with 6.31 L* value, -0.22 a* value, 8.76 b* value and colour of the star fruit beverage was light yellowish orange with colour value of L* = 77.30, a* = -6.60 and b* = 23.14.

2.4 Changes in chemical composition of blended RTS during storage

Bhatia *et al.* (1956) reported that the degree of reduction in acidity was dependent on the concentration of sugar and it is a general phenomenon during storage of beverages in the presence of sugars.

Pal and Sethi (1992) reported the increasing trend in T.S.S. and a decreasing trend in acidity during 3 months of storage of kagzi lime syrup.

Shinde (1993) observed that there was an increasing trend in T.S.S., reducing sugars, total sugars and a decreasing trend in the acidity of syrup prepared from ripe sapota cv. Kalipatti fruits during 150 days of storage.

Jadhav (1996) observed an increasing trend in T.S.S. and a decreasing trend in acidity during 8 month's storage of syrup prepared from raw and ripe kokum and karonda fruits.

Gosavi (1998) reported the increasing trend in T.S.S. and a decreasing trend in the acidity during 180 days storage of kokum and karonda syrup

Marimuthu and Thirumaran (2000) prepared the syrup from jamun juice and they observed a gradual increase in T.S.S., reducing and total sugars during the 6 months of storage.

Kulkarni (2000) reported a decreasing trend in acidity and increasing trend in T.S.S. of mango cv. Ratna fruit syrup.

Kannan and Thirumaran (2004) studied the storage life of jamun fruit products. They reported that the T.S.S of jamun syrup was increased from 70.0 to 72.50 brix during 6 months of storage. They also illustrated the increasing trend of reducing sugars from 39.4 to 46.6 per cent and a decrease in the acidity from 2.0 to 1.96 per cent during 6 months of storage.

Bhandari (2004) observed the increasing trend in T.S.S., reducing sugars, total sugars and a decreasing trend in the acidity of jamun syrup during storage of 6 months at ambient temperature.

Reddy and Chikkasubbanna (2009) studied the storage behaviour of amla syrup. They observed an increasing trend in total soluble solids, reducing sugars, total sugars and a decreasing trend in acidity and non-reducing sugars during storage.

Shikhare (2014) prepared sapota syrup blended with kokum juice and he observed an increasing trend in total soluble solids, reducing sugars, total sugars and a decreasing trend in acidity during storage.

Korgaonkar *et al.* (2015) prepared the snap melon syrup and they observed an increasing trend in total soluble solids, reducing

sugars, total sugars and a decreasing trend in acidity during storage.

2.5 Sensory evaluation of blended RTS.

Boghani *et al.* (2012) prepared blended papaya: *Aloe vera* RTS beverage. The storage studies revealed that the blended papaya: *Aloe vera* juice with 90 per cent papaya juice and 10 per cent aloe vera juice was the best in all proportion.

Byanna and Gowda (2012) prepared sweet orange and pomegranate blended RTS beverage and reported that sweet orange and pomegranate were mixed at the ratio of 50:50 with 15 per cent juice, TSS of 15˚brix and 0.3 per cent acidity was found to be the best in taste and overall acceptability.

Sindhumati and Premlata (2015) prepared naturally flavored papaya: pineapple blended RTS beverage and reported that 50:50 proportion of papaya:pineapple blended RTS was the best at organoleptic score.

Bhavya and Vanjalata (2015) reported the decrease in organoleptic score of blended sweet orange and pomegranate juice during 3 monthes of storage.

2.6 Microbial spoilage

Attri *et al.* (1998) found that the blends of sand pear juice with apple, apricot and plum could be stored at room temperature for six months without any spoilage.

Ejechi *et al.* (1998) reported that heating mango juice to 55^0C for 15 minutes and supplementing with nutmeg (4% v/v) and ginger (4% v/v) markedly inhibited microbial growth.

Deka (2000) reported negligible growth of moulds and yeasts in lime-aonla and mango-pineapple spiced – RTS beverages, which got further reduced during storage due to inhibitory effect and antioxidative properties of spices.

Chopra and Singh (2009) observed that the standard plate count determined in Malta orange squash was found to be quite safe after a storage period of 90 and 105 days and stored at 25±2°C.

Reddy and Chikkasubhana (2009) reported that the amla syrup was free from microbial spoilage during storage period of 90 days. There were no defective remarks regarding the fermentation of syrup by the organoleptic evaluation panel.

Lad *et al.* (2012) reported that the squash prepared from lime Cv. Sai Sarbati was free from microbial spoilage after 90 days of storage.

Kalunkhe *et al.* (2014) observed that the squash prepared from Konkan lemon stored at ambient conditions for three months, did not show any growth of bacteria as well as fungi.

CHAPTER – II
REVIEW OF LITERATURE

The research entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.): pomegranate (*Punica granatum*) RTS" is reviewed in the current chapter under the following headings. Since very limited work has been reported on processing of blended pineapple: pomegranate RTS, the literature in this regard on other important fruit crops is also reviewed.

2.1 Juice recovery of pineapple and pomegranate fruits

2.2 Chemical composition of fresh pineapple and pomegranate

2.3 Preparation of blended RTS

2.4 Physical parameters of blended RTS

2.5 Changes in chemical composition of blended RTS during storage

2.6 Sensory evaluation of blended RTS

2.7 Microbial spoilage

2.1 Juice recovery of pineapple and other fruits

Khurdiya and Roy (1985) studied various methods of jamun juice extraction and found that the juice yield varied according to the method used. Hand crushing and basket pressing reported the minimum juice yield (32%) while steaming (5 min.) and basket pressing yielded 41.8 per cent juice. Different juice recoveries were recorded due to effect of heating, incorporation of water and

enzyme treatments, hand crushing, heating, steaming, pulping, grating and basket pressing.

Sonkar and Ladaniya (1995) reported that the juice yield in nagpur mandarin after 15 days interval ranged from 32 to 42 per cent.

Saxena *et al.* (1996) recorded 57 per cent juice yield in grape (var. Perlette) and 69.2 per cent in mango (var. Langra) extracted by cold pressing method.

Dalvi (1998) reported the juice recovery in kokum, jamun, sapota and pineapple fruits as 29.84, 40.74, 34.34 and 42.01 per cent, respectively.

Asgekar (2002) reported 50.59 per cent juice recovery in pineapple CV. Kew.

Bhatnagar and Chandra (2002) studied the acid lime cv. Kagzi lime in the nine orchards of fruit growers in Rajasthan state and reported that the average fruit juice recovery was ranged from 37.94 to 46.78 per cent.

Dhutade (2012) reported that sapota juice recovery was 40 per cent.

Shikhare (2014) observed that the average juice recovery of sapota fruit was 36.5 per cent.

Chavan (2015) observed 50.30 per cent juice recovery in pineapple fruit.

2.2 Chemical composition of fresh pineapple and pomegranate fruit

2.2.1. Total soluble solids (T.S.S.)

Kumbhar *et al.* (2002) conducted an experiment to study the effect of methods of juice extraction on the quality of pomegranate

wine and observed 14.6 °B total soluble solids by hand press method.

Chatterjee *et al.* (2005) reported maximum TSS (25 %) in Amrapali fruits at ripe stage.

Rashmi *et al.* (2005) observed that the average TSS of pineapple fruits was 14.5˚Brix.

Dhumal *et al.* (2013) worked on the development of pomegranate juice processing technology and observed 14.80 °B total soluble solid contents in pomegranate juice.

Hire (2013) conducted an experiment on preparation of blended pomegranate and cashew apple nectar and recorded 14.4 °B total soluble solid content in pomegranate fruit.

2.2.2. Titratable acidity

Hossain *et al.* (2001) reported highest 0.87 per cent titratable acidity in cv. Bishawanath, followed by 0.79 and 0.60 per cent in Amrapali and Mallika fruits, respectively.

Kumbhar *et al.* (2002) conducted an experiment to study the effect of methods of juice extraction on the quality of pomegranate wine and observed 0.35 per cent titratable acidity in the juice extracted by hand press method.

Rashmi *et al.* (2005) observed that the pineapple had 0.66 percent acidity.

Dhumal *et al.* (2013), while working on the development of pomegranate juice processing technology observed 0.46 per cent titratable acidity in pomegranate juice.

Hire (2013) conducted an experiment on the preparation of blended pomegranate and cashew apple nectar and recorded 0.39 per cent titratable acidity in pomegranate fruit.

2.2.3. Sugars (reducing and total sugars)

Rashmi *et al* (2005) observed that average reducing sugar content in pineapple was 6.44 per cent reducing sugars and 13.76 per cent total sugars.

Dhumal *et al.* (2013), while developing the pomegranate juice processing technology, observed 14.70 per cent reducing sugar content in pomegranate juice.

Hire (2013) conducted an experiment on the preparation of blended pomegranate and cashew apple nectar. They reported 12 per cent reducing sugar content and 13.31 per cent total sugar content in pomegranate fruit.

2.3 Preparation of blended RTS

Hire (2013) prepared blended pomegranate and cashew apple nectar of different proportions (60:40, 70:30, 80:20, 90:10, 100:00, 00:100). Combination of 80:20 proportion of pomegranate and cashew apple was the best for preparation of blended nectar.

Sindumati and Premalata (2013) carried out an experiment to study the feasibility of blending papaya and pineapple in different ratios such as 80:20, 70:30, 60:40, and 50:50, out if which the ratio of 50:50 was reached the highest sensory scores for overall acceptability.

Deen and Kumar (2014) worked on blended RTS of mango and ginger juice. The study revealed that the palatable RTS

beverage with 13˚ B TSS and 0.25 per cent acidity could be prepared using 12 per cent of blend comprising mango pulp and ginger juice in 9:1 ratio. The TSS, acidity, reducing sugars and total sugar content increased, whereas ascorbic acid and non-reducing sugar content decreased during storage.

Bhavya and Vanajalata (2015) prepared blended pomegranate: sweet orange RTS (18% juice, 15˚B RTS and 0.3% acidity). Out of which sweet orange: pomegranate juice ratio of (60:40) was the best proportion for the preparation of blended RTS.

Tiwari and Deen (2015) prepared the RTS beverage from a blend consisting 75 per cent bael pulp and 25 per cent *Aloe vera* gel which was the most acceptable than other blends.

2.3.1 Colour (L*, a* and b* values)

Spayd *et al.* (1984) observed that the black raspberry-apple blends stored at 25^0 C for 48 hours resulted in increased polymeric colour and per cent colour due to increased tannins, while anthocyanin concentration decreased.

Khurdiya (1993) observed that the Amrapali mango nectar possessed 1.22, 6.79 and 1.19 times higher values of L, + a and + b than those of Totapuri, respectively.

Deka (2000) reported a decreasing trend in hunter L* and a* values and increasing trend in b* value and colour differences during storage of lime-aonla and mango-pineapple spiced RTS beverages in different containers under various storage conditions.

Rein and Heinonen (2004) reported the L*, a*, b*, c* and h* values of different juices of berries in studies on stability and enhancement of berry juice colour.

Lee Siew Yoong (2006) reported the colour of diluted calamansi fruit juice was greenish yellow with colour values of L*= 23.1, a*= -1.1, b*= 20.9 and colour of pineapple juice and pineapple beverage was light yellow with 44.44 and 64.62 L* values, 1.14 and 0.53 a* values and 25.43 and 25.90 b* values, respectively. They also reported that the star fruit juice was dark yellowish orange with 6.31 L* value, -0.22 a* value, 8.76 b* value and colour of the star fruit beverage was light yellowish orange with colour value of L* = 77.30, a* = -6.60 and b* = 23.14.

2.4 Changes in chemical composition of blended RTS during storage

Bhatia *et al.* (1956) reported that the degree of reduction in acidity was dependent on the concentration of sugar and it is a general phenomenon during storage of beverages in the presence of sugars.

Pal and Sethi (1992) reported the increasing trend in T.S.S. and a decreasing trend in acidity during 3 months of storage of kagzi lime syrup.

Shinde (1993) observed that there was an increasing trend in T.S.S., reducing sugars, total sugars and a decreasing trend in the acidity of syrup prepared from ripe sapota cv. Kalipatti fruits during 150 days of storage.

Jadhav (1996) observed an increasing trend in T.S.S. and a decreasing trend in acidity during 8 month's storage of syrup prepared from raw and ripe kokum and karonda fruits.

Gosavi (1998) reported the increasing trend in T.S.S. and a decreasing trend in the acidity during 180 days storage of kokum and karonda syrup

Marimuthu and Thirumaran (2000) prepared the syrup from jamun juice and they observed a gradual increase in T.S.S., reducing and total sugars during the 6 months of storage.

Kulkarni (2000) reported a decreasing trend in acidity and increasing trend in T.S.S. of mango cv. Ratna fruit syrup.

Kannan and Thirumaran (2004) studied the storage life of jamun fruit products. They reported that the T.S.S of jamun syrup was increased from 70.0 to 72.50 brix during 6 months of storage. They also illustrated the increasing trend of reducing sugars from 39.4 to 46.6 per cent and a decrease in the acidity from 2.0 to 1.96 per cent during 6 months of storage.

Bhandari (2004) observed the increasing trend in T.S.S., reducing sugars, total sugars and a decreasing trend in the acidity of jamun syrup during storage of 6 months at ambient temperature.

Reddy and Chikkasubbanna (2009) studied the storage behaviour of amla syrup. They observed an increasing trend in total soluble solids, reducing sugars, total sugars and a decreasing trend in acidity and non-reducing sugars during storage.

Shikhare (2014) prepared sapota syrup blended with kokum juice and he observed an increasing trend in total soluble solids, reducing sugars, total sugars and a decreasing trend in acidity during storage.

Korgaonkar *et al.* (2015) prepared the snap melon syrup and they observed an increasing trend in total soluble solids, reducing

sugars, total sugars and a decreasing trend in acidity during storage.

2.5 Sensory evaluation of blended RTS.

Boghani *et al.* (2012) prepared blended papaya: *Aloe vera* RTS beverage. The storage studies revealed that the blended papaya: *Aloe vera* juice with 90 per cent papaya juice and 10 per cent aloe vera juice was the best in all proportion.

Byanna and Gowda (2012) prepared sweet orange and pomegranate blended RTS beverage and reported that sweet orange and pomegranate were mixed at the ratio of 50:50 with 15 per cent juice, TSS of 15˚brix and 0.3 per cent acidity was found to be the best in taste and overall acceptability.

Sindhumati and Premlata (2015) prepared naturally flavored papaya: pineapple blended RTS beverage and reported that 50:50 proportion of papaya:pineapple blended RTS was the best at organoleptic score.

Bhavya and Vanjalata (2015) reported the decrease in organoleptic score of blended sweet orange and pomegranate juice during 3 monthes of storage.

2.6 Microbial spoilage

Attri *et al.* (1998) found that the blends of sand pear juice with apple, apricot and plum could be stored at room temperature for six months without any spoilage.

Ejechi *et al.* (1998) reported that heating mango juice to 55^0C for 15 minutes and supplementing with nutmeg (4% v/v) and ginger (4% v/v) markedly inhibited microbial growth.

Deka (2000) reported negligible growth of moulds and yeasts in lime-aonla and mango-pineapple spiced – RTS beverages, which got further reduced during storage due to inhibitory effect and antioxidative properties of spices.

Chopra and Singh (2009) observed that the standard plate count determined in Malta orange squash was found to be quite safe after a storage period of 90 and 105 days and stored at 25±2°C.

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Lad *et al.* (2012) reported that the squash prepared from lime Cv. Sai Sarbati was free from microbial spoilage after 90 days of storage.

Kalunkhe *et al.* (2014) observed that the squash prepared from Konkan lemon stored at ambient conditions for three months, did not show any growth of bacteria as well as fungi.

CHAPTER – III

MATERIAL AND METHODS

The present research work entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.): pomegranate (*Punica granatam*.) RTS" was undertaken in the Department of Post-Harvest Management of Fruit, Vegetable and Flower Crops in Post Graduate Institute of Post-Harvest Management, Killa-Roha, during the year 2015-2016. The blended RTS was prepared by using pineapple and pomegranate juice. The material used and methods adopted during the course of investigation are presented in this chapter.

3.1 Experimental material

The pineapple and pomegranate fruits required for conducting research were procured from Agriculture Produce Marketing Committee (APMC), Pune.

The experiment entitled, "studies on preparation of blended pineapple: pomegranate RTS" was laid out with five main treatments, four sub treatments and three replications. The experimental details are listed as below.

3.1.1 Experimental details

1.	Fruit	**:**	Pineapple (*Ananas comosus* L.) and Pomegranate (*Punica granatum*.)
2.	Design	:	F.C.R.D.
3.	Number of treatment combinations	:	5x4=20
4.	Replications	:	3

I) Details of treatment

The treatments comprised of different proportions of pineapple and pomegranate juice in the blended RTS are as given below.

A. Main treatments	Proportion of pineapple and pomegranate juice
T1:	100:0
T2:	90:10
T3:	80:20
T4:	70:30
T5:	60:40

B. Sub treatments	**Storage period (Days)**
S-1 :	0 Days
S-2 :	30 Days
S-3 :	60 Days
S-4 :	90 Days

3.2 Methods

3.2.1 Per cent juice recovery

To determine the juice recovery, the known weight of fruit was taken and juice was extracted from fruit. The weight of fruit was measured by means of monopan electronic balance. The recovery percentage of juice was calculated by the following formula,

$$\text{Juice recovery (\%)} = \frac{\text{Weight of juice (g)}}{\text{Weight of fresh fruit (g)}} \text{ X } 100$$

3.2.2 Chemical composition of the pineapple (*Ananas comosus* L.) and pomegranate (*Punica granatum)* var. Bhagwa Juice.

The following chemical constituents were determined from pineapple and pomegranate juice during the course of investigation.

3.2.2.1 Total soluble solids (T.S.S.)

Total soluble solids were determined using Hand refractometer (Erma Japan, 0-32 ^{0}B) and the values were corrected at 20^0 C with the help of temperature correction chart (A.O.A.C., 1975).

3.2.2.2 Titratable acidity

A known quantity of sample was titrated against 0.1 N NaOH solution using phenolphthalein as an indicator. 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 0.1 N sodium hydroxide (NaOH) solution using phenolphthalein as an indicator (Ranganna, 1997). The results were expressed as per cent anhydrous citric acid.

Total acidity(%)

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

3.2.2.3 Reducing sugars

The reducing and total sugars were estimated by using Lane and Eynon method with modifications suggested by Ranganna (1997). A known weight of sample was blended with distilled water using lead acetate (45%) for precipitation of extraneous material and potassium oxalate (22%) to de-lead the solution. This lead free

extract was used to estimate reducing sugars by titrating against standard Fehling's mixture (Fehling A and B in equal proportion) using methylene blue as an indicator to a brick red end point.

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

3.2.2.4 Total sugars

Total sugars were estimated by the same method after acid hydrolysis of an aliquot of de-leaded sample with 50 per cent hydrochloric acid followed by neutralization with 40 per cent sodium hydroxide.

$$\text{Total sugars (\%)} = \frac{\text{Factor x Dilution}}{\text{Titrate reading x Weight of sample}}$$

3.2.3 Preparation and evaluation of pineapple *(Ananas comosus* L.*)* pomegranate (*Punica granatum*) blended RTS

3.2.3.1 Selection and preparation of fruits

The fully ripe, fresh and sound pineapple fruits were selected for the preparation of blended RTS. The fruits were washed with water to remove dirt and dust. After peeling, the pineapple fruits were cut into slices and core was removed. The pineapple slices were then passed through mixer and the extracted juice was strained through muslin cloth. The fully ripe, fresh pomegranate fruits were selected for blending with pineapple juice. The fruits

were washed with water to remove the dirt and dust. After peeling the arils were separated and juice was extracted by squeezing the arils in muslin cloth. The extracted juice was strained through muslin cloth to obtain clean juice for the preparation of blended product.

3.2.3.2 Preparation of blended RTS

For the preparation of blended RTS, the pineapple and pomegranate juice were mixed together in different ratios as per the treatments. After evaluating the blends for the TSS and acidity, a required quality of sugar and citric acid was added to the mixture to maintain 10˚ Brix TSS and 0.3 per cent acidity of the blended RTS. The mixture was then heated to dissolve the sugar completely. Before hot filling, the sodium benzoate @ 100 ppm was added to the blended RTS.

3.2.3.3 Filling and storage of the blended RTS

The product was then hot filled in pre-sterilized glass bottles. The bottles were then sealed air tight, pasteurized, labelled and stored at a cool and dry place at ambient temperature conditions for further investigation.

3.2.4 Storage behaviour of blended RTS

The RTS was stored at ambient temperature conditions to study the storage behaviour of the product with respect to the changes in physical, chemical and sensory qualities during storage. The product was evaluated immediately after preparation and at an interval of 30 days up to 90 days of storage.

3.2.5. Changes in the physical parameters of blended RTS

3.2.5.1 Colour

The colour of RTS was determined as L*, a* and b* values using a colorimeter (make Konika Minolta, Japan) which denote lightness, red colour and yellow colour, respectively.

3.2.6 Changes in chemical composition of the RTS during storage

The changes in chemical constituents such as T.S.S., titratable acidity, reducing sugars and total sugar content of the blended RTS were determined at an interval of 30 days up to 90 days of storage. The procedure followed to determine the chemical constituents is as described in 3.2.2.1 to 3.2.2.4.

3.2.7 Microbial analysis

The microbial analysis of the RTS was carried out at 0 day and after 90 days of storage as per the method described by Kiiyukia (2003).

Nutrient Agar media was prepared by weighing required quantity of nutrient agar and diluted with double distilled water to a known volume. The media was then autoclaved at 121^0 C for 20 min. When the temperature of media reached to 40^0 C, it was used for plating.

The plating was carried out with 0.1 ml sample in sterile petri plates under the Laminar Air Flow. The sample of each treatment was taken on a separate petri plate, followed by pouring of approximately 20 ml of media (35-40^0 C) on the sample and mixing was done by tilting plate properly. Plates were sealed with Para film and incubated at 37^0 C for 48 hrs to check bacterial count and it was kept for 5-6 days at room temperature for fungal count. Total

microbial plate count was measured in colony forming unit/gram (cfu/g).

3.2.8 Changes in organoleptic qualities of the blended RTS

The product was evaluated for their organoleptic qualities like colour, flavour and overall acceptability on a hedonic scale (Amerine *et al.*, 1965) as given below.

Sr. No.	Organoleptic score	Rating
1.	9	Like extremely
2.	8	Like very much
3.	7	Like moderately
4.	6	Like slightly
5.	5	Neither liked nor disliked
6.	4	Dislike slightly
7.	3	Dislike moderately
8.	2	Dislike very much
9.	1	Dislike extremely

(Source: Amerine *et al.*, 1965)

The overall rating was obtained by averaging score of evaluation. The RTS with organoleptic score of 5.5 and above was rated as acceptable.

3.2.9 Statistical Analysis

The data collected on physical parameters of pineapple and pomegranate fruits such as juice recovery and chemical parameters *viz.,* T.S.S., acidity, sugars were represented as mean values. The data collected on the changes in physico-chemical composition and organoleptic qualities were statistically analysed by the standard procedure given by Panse and Sukhatme (1985) using Factorial

Completely Randomized Design (FCRD) and valid conclusions were drawn only on significant differences between treatment mean at 0.05 per cent level of significance.

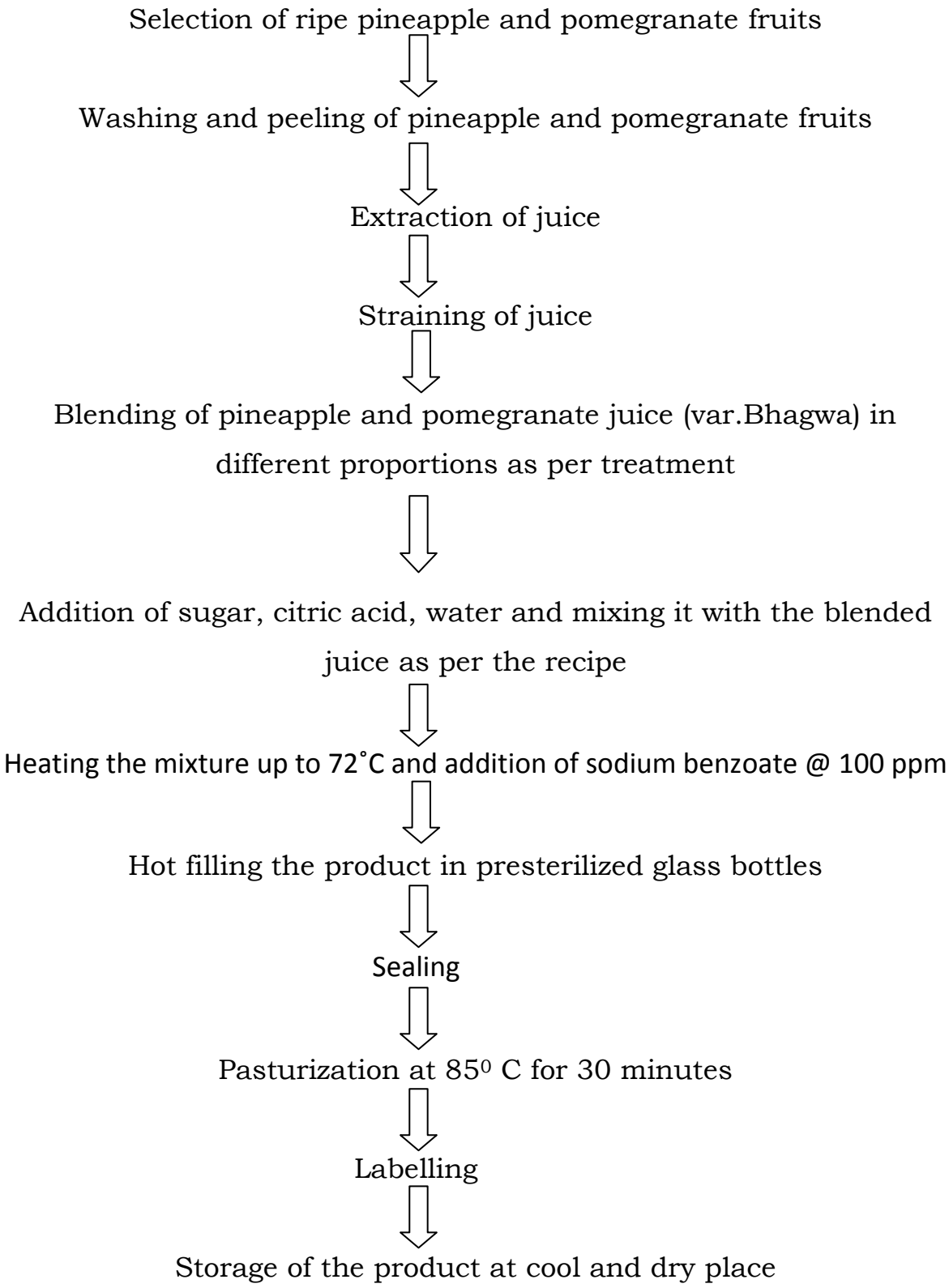
3.2.10 Economics

The economics of the product was worked out by considering existing rates of various inputs such as cost of raw material, labour, fuel, electricity, packaging, depreciation (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 calculated by adding 20 per cent profit margins to the cost of product. The net profit was calculated for different treatments of the experiments.

FLOW-CHART - I

Preparation of pineapple-pomegranate blended RTS


Selection of ripe pineapple and pomegranate fruits
Washing and peeling of pineapple and pomegranate fruits
Extraction of juice
Straining of juice
Blending of pineapple and pomegranate juice (var.Bhagwa) in different proportions as per treatment
Addition of sugar, citric acid, water and mixing it with the blended juice as per the recipe
Heating the mixture up to 72˚C and addition of sodium benzoate @ 100 ppm
Hot filling the product in presterilized glass bottles
Sealing
Pasturization at 85⁰ C for 30 minutes
Labelling
Storage of the product at cool and dry place

CHAPTER – IV

RESULTS AND DISCUSSION

The research project entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.) pomegranate (*Punica granatum*) RTS" was undertaken 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 2015 – 2016. The results of the experiment under study are presented and discussed in this chapter.

4.1 Per cent juice recovery and chemical composition

4.1.1 Per cent pineapple juice recovery

The data pertaining to the pineapple juice recovery are presented in Table 1 and it could be observed from the data that the average juice recovery in pineapple was 49.38 per cent.

Asgekar (2002) reported 50.59 per cent juice recovery in pineapple CV. Kew. and Dalvi (1998) reported the juice recovery in pineapple as 42.01 per cent.

4.1.2 Per cent pomegranate juice recovery

The data pertaining to the juice recovery in pomegranate are presented in Table 1 and it could be observed from the data that the average juice recovery in pomegranate was 43 per cent.

Priyanka *et al.* (2013) reported 50 per cent juice recovery in pomegranate fruit.

4.1.3 Chemical composition of fruit juice

The data regarding the chemical composition of fruit juices are presented in Table 1 and Table 2.

4.1.3.1 Total soluble solids (° B)

4.1.3.1 a) Pineapple

The data regarding the total soluble solids content of pineapple juice presented in Table 1 indicate that pineapple fruit juice recorded the average T.S.S. of 12.5 ^{0} Brix.

Rashmi *et al.* (2005) observed that the average TSS of pineapple fruits was 14.5˚Brix.

4.1.3.1 b) Pomegranate

The data regarding the total soluble solids content of pomegranate fruit juice presented in Table 2 indicate that the total soluble solids (T.S.S.) content of pomegranate fruit was 16.2 ^{0}Brix. Identical observation was also reported by Dhumal *et al.* (2013) in Bhagwa cultivar of pomegranate.

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4.1.3.2 Titratable acidity (%)

4.1.3.2 a) Pineapple

The results presented in Table 1 indicate that the average titratable acidity of pineapple juice was 0.56 per cent.

Khurdiya (1987) reported the acidity of pineapple juice in the range of 0.3 to 0.8 per cent.

4.1.3.2 b) Pomegranate

The results presented in Table 2 indicate that the average titratable acidity of pomegranate juice was 0.38 per cent. The finding was similar to the observations reported by Dhumal *et al.* (2013) in Bhagwa cultivar of pomegranate.

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4.1.3.3 Sugars (reducing and total sugars) (%)

4.1.3.3 a) Pineapple

The data with respect to reducing and total sugars of pineapple juice are presented in Table 1. The reducing and total sugar content of pineapple juice was 3.86 and 9.18 per cent, respectively. The similar observations were also recorded by Amravati (2014) who reported the reducing and total sugar content in pineapple juice as 4.02 to 13.16 per cent, respectively.

4.1.3.3 b) Pomegranate

The data with respect to reducing and total sugars of pomegranate fruit are presented in Table 2. The per cent reducing and total sugar content of pomegranate fruit was 13.4 and 15.01 per cent, respectively. The observation in accordance with this finding was reported by Hire (2013).

4.2 Changes in physico-chemical composition of blended RTS during storage

4.2.1 Physical parameters of blended RTS

4.2.1.1 Colour (L*, a* and b* value)

4.2.1.1.1 L* value for colour

The data presented in Table 3 and Fig. 1 with respect to the L* value for colour of the blended RTS revealed that the L* value for colour influenced significantly due to recipe treatments as well as the storage period. The treatment T1 recorded highest (82.34) mean L* value for colour, followed by the treatments T2 (81.02) and T3 (79.46). The lowest (74.74) mean L* value for colour was observed in

the treatment T5. It is observed from the data that the L* value declined with rise in the level of pomegranate juice in the blended RTS as the pomegranate juice increased the cloudiness of blended RTS.

The colour L* value varied significantly during storage irrespective of the treatments. The decreasing trend was observed up to 90 days of storage. The highest mean (82.54) colour L* value was recorded at 0 days of storage and the lowest (73.62) mean colour L* value was observed at 90 days of storage. A decline in L* value for colour might be due to darkening of the product during storage.

The interaction between treatments and the storage period was found statistically significant. It is evident from the data that is L* value for the colour of the product was maximum (85.36) initially in the treatment T1 whereas it was minimum (63.71) in the treatment T5 after 90 days of storage.

Similar results were recorded by Deka (2000) who reported a decreasing trend in hunter L* values and colour differences during storage of lime-aonla and pomegranate-pineapple spiced RTS beverages in different containers under various storage conditions.

4.2.1.1.2 a* value for colour

The data presented in Table 4 and Fig. 2 exhibit the colour a* value of blended RTS. It is observed from the data that the colour a* value varied significantly due to the treatments and storage period.

It is also clear from the data that the treatment T5 recorded highest (5.23) mean a* value for colour, followed by the treatment T4 (4.12). The lowest (2.28) treatment mean found in T2 which was at par with the treatment T1 (2.45). The a* value for the colour indicates the redness of the product. The increased proportion of

pomegranate juice in the product darkened the colour of the blended RTS.

The colour a* value varied significantly during storage irrespective of the treatments. The increasing trend was noticed up to 90 days of storage. The highest (4.43) mean a* value for colour was recorded at 90 days of storage and the lowest (2.48) mean a* value for colour was observed at 0 days of storage. The increase in a* value for colour indicates darkening of red colour of the product during storage at ambient condition.

The interaction effects related to a* value for colour between recipe treatment and the storage period were found statistically significant. It is evident from the data that the treatment T1 recorded minimum (1.39) a* value for colour at 0 day of storage whereas it was maximum (7.34) in the treatment T5 after 90 days of storage ambient condition.

The similar observations to this are also reported by Deka (2000) who observed an increasing trend in a* values for colour during storage of lime-aonla and pomegranate-pineapple spiced RTS beverages in different containers under various storage conditions.

4.2.1.1.3 b* value for colour

The data with respect to the colour b* value of blended RTS are presented in Table 5 and Fig. 3. It was observed that the colour b* value was influenced by the recipe treatments and storage period. The treatment T5 recorded highest mean (3.23) b* value. The lowest (-3.63) b* value for colour was observed in the treatment T1, followed by the treatment T2 (-2.54).

The colour b* value varied significantly during storage irrespective of the treatments up to 90 days of storage and there

was an increase in b* value for colour after 90 days of storage period. The highest (3.23) mean b* value for colour was recorded at 90 days of storage and the lowest (-1.45) mean b* value for colour was observed after 0 days of storage

The interaction between treatments and storage period for b* value for colour was statistically significant. The significantly highest (4.31) b* value for colour was observed in the treatment T5 at 90 days of storage whereas it was lowest (-5.83) in the treatment T1 initially i.e. at 0 days of storage.

Deka (2000) reported an increasing trend in b* value and colour differences during storage of lime-aonla and pomegranate-pineapple spiced RTS beverages in different containers under various storage conditions.

4.2.2 Chemical parameters of blended RTS

4.2.2.1 Total soluble solids (^{0} B)

It is evident from the data presented in Table 6 and illustrated in Fig. 4 that there was an increase in the T.S.S. during storage of blended RTS. It could be observed from the data that the T.S.S. of the blended RTS varied significantly due to the treatments under study. Among the treatments, the highest (10.33°B) mean was noticed in the treatment T1 which was significantly superior to rest of the treatments. This could be due to the relatively higher TSS maintained at the time of preparation of blended RTS. The treatment T4 exhibited significantly minimum (10.05°B) mean T.S.S. among all treatments. However, it was at par with the treatments T3 (10.06°B), T5 (10.07°B) and T2 (10.09).

It is evident from the results that initially, the blended RTS exhibited a minimum (10.03°B)) mean T.S.S. and it was significantly increased to maximum (10.20^0 B) after 90 days of storage period.

The interaction between treatments and storage was recorded as statistically non-significant. An increase in total soluble solids of RTS during storage might be due to hydrolysis of polysaccharides like starch, cellulose and pectin substance into simpler substances. Similar results were recorded by Balaji and Prasad (2014). According to them, the TSS of kinnow:aonla blended RTS increased from 15.01°B to 15.13°B during 6 months of storage.

Similar results were also recorded by Awsi and Er.Dorcus (2012) in pineapple:carrot:orange blended juice; Sindhumati and Premlata (2013) in papaya:pineapple RTS beverage and Bhavya and vanjalata (2015) in sweet orange:pomegranate RTS.

4.2.2.2 Titratable acidity

It could be observed from the results presented in Table 7 and Fig. 5 that the titratable acidity of blended RTS varied significantly with different recipe treatments as well as the storage period. It is noticed from the results that the acidity of the blended pineapple: pomegranate RTS was highest in the treatment T5 (0.307%). The treatment T1 recorded lowest (0.299%) mean titratable acidity.

It was also noticed from the Table 7 that the mean titratable acidity was significantly increased from initial 0.29 per cent to 0.32 per cent up to 90 days of storage period. Acidity increased during storage due to release of acids from pulp/juice particles due to autolysis of cells. The interaction between treatment and storage period was found to be statistically non-significant.

Similar observations were reported by Awsi and Er.Dorcus (2012) in pineapple:carrot:orange blended juice; Sindhumati and Premlata (2013) in papaya:pineapple RTS beverage and Bhavya and Vanjalata (2015) in sweet orange:pomegranate RTS.

4.2.2.3 Reducing sugars

The data presented in Table 8 and illustrated graphically in Fig. 6 indicate that the blended RTS recipe as well as storage period exhibited significant changes in the reducing sugar content of the blended RTS.

The mean reducing sugar content was highest (5.08%) in the treatment T5, followed by the treatments T4 (4.60%) and T3 (4.16%). The lowest (3.61%) mean reducing sugar content was noticed in the treatment T1, followed by the treatment T2 (3.90%).

It is observed from the data that the reducing sugar content increased with the increase in the level of pomegranate juice in the blended RTS.

The variation in reducing sugars during storage was found significant after three months of storage period. The reducing sugar content of the blended RTS was increased from 3.98 to 5.08 per cent after 90 days of storage.

The interaction between treatments and storage period was found non-significant.

The reducing sugars were found to increase with the advancement of the storage period. This increase might be due to hydrolysis of non-reducing sugars into reducing sugars. Similar results were obtained by Yadav *et al.* (2014) in guava-pomegranate squash, Reddy and Chikkasubbanna (2009) in amla syrup, Kalunkhe *et al.* (2014) in lemon squash cv. konkan seedless,

Korgaokar *et al.* (2014) in snap melon syrup and Ulah *et al.* (2015) in blended carrot:kinnow RTS.

4.2.2.4 Total sugars

It is evident from the data presented in Table 9 and graphically presented in Fig. 7 that the total sugar content of blended RTS exhibited variation due to the treatment and it increased significantly during storage.

The variation in total sugars due to different treatments was found significant. The treatment T5 recorded the highest (8.87%) mean total sugars, however it was at par with the treatment T4. The treatment T1 recorded significantly lowest (7.58) mean total sugar content of the blended RTS, followed by the treatment T2. Thus, it is clear from the data that the pomegranate juice level in the product had significant effect on the total sugar content of the product. An increasing trend in the total sugar content was noticed with rise in the relative proportion of the pomegranate juice in the product.

The total sugar content increased significantly from 7.60 per cent at the time of preparation to 9.02 per cent after 90 days of storage. The interaction between treatment and storage period was found non-significant

A significant increase in the total sugar content of the product was noticed up to 90 days of storage. This could be attributed to the fact that the hydrolysis of polysaccharides during storage resulted into increase in the soluble sugars. It is also reported by Yadav *et. al*. (2014) in Guava-pomegranate squash. Similar results were obtained by Marimuthu and Thirumaran (2000) in jamun syrup

where the total sugar content was increased from 65.00 to 68.30 per cent during 3 months of storage.

Kannan and Thirumaran (2003) reported the increase in total sugar content of jamun syrup from 63.00 to 69.20 per cent in 6 months of storage period. The identical results were also reported by Reddy and Chikkasubbanna (2009) in amla syrup and Kalunkhe *et al.* (2014) in lemon squash cv. Konkan seedless.

4.3 Microbial analysis of blended RTS

The microbial growth for bacteria as well as for fungi of Blended RTS was carried out during storage. It could be observed from the results presented in Table 10 that the microbial growth in pineapple:pomegranate blended RTS was not observed during storage and the product was totally free from bacteria as well as fungi throughout the storage period of 90 days.

Analogues observations were recorded by Reddy and Chikkasubhana (2008) and they reported that Lime blended amla squash was free from microbial spoilage during storage period of 90 days.

4.4 Changes in organoleptic qualities of pineapple:pomegranate blended RTS during storage

It could be revealed from the data that the pineapple:pomegranate blended RTS prepared according to the recipes under study was found to be organoleptically quite acceptable not only at the time of preparation but also throughout the storage period of 90 days.

4.4.1 Colour

The data on the changes in the organoleptic score for colour of blended RTS influenced by different treatments and storage period are presented in Table 11 and graphically illustrated in Fig. 8.

It could be noticed from the data that the changes in the organoleptic score for colour of the RTS, prepared by five different treatments were statistically significant. The treatment T1 recorded highest (7.75) mean score for colour, the lowest mean (6.79) score for colour was recorded by the treatment T4. However, it was at par with the treatments T3 (6.92). Also, the treatment T2 (7.13) and T5 (7.25) were at par with each other.

Thus, it is clear from the data that the straight pineapple RTS had better colour than the blended pineapple:pomegranate RTS. Among all the blends, the sensory score for the colour was better when the level of pomegranate juice in the RTS raised 40 per cent (T5) and it was comparable with the blended RTS with 90:10, pineapple:pomegranate ratio. Moreover, the blended RTS with 20 or 30 per cent (T3 and T4) pomegranate juice had dull pinkish colour (Plate I) which was not much liked by the panel.

The variation in the organoleptic score for colour during storage was found statistically significant. The significantly higher (7.63) mean organoleptic score for colour was recorded immediately after preparation which was decreased with increase in the storage period.

The interaction effect between storage and treatment was found to be statistically significant. The maximum organoleptic score for colour was recorded in the Treatment T1 (8.00, 7.83 and 7.66, respectively) at 0, 30 and 60 days of storage, and the treatment T5 (8.00 and 7.83, respectively) at 0 and 30 days of storage. The lowest organoleptic score for colour was recorded in

treatment T5 (6.00) at 90 days of storage but it was at par with the treatment T4 at 90 days of storage.

Analogous observation to these finding were reported by Awsi and Er.Dorcus (2012) in pineapple:carrot:orange blend juice; Sindhumati and Premlata (2013) in papaya:pineapple RTS beverage and Bhavya and Vanjalata (2015) in sweet orange:pomegranate RTS.

4.4.2 Flavour

The changes in the organoleptic score for flavour of blended RTS are presented in Table 12 and illustrated in the Fig 9.

It is observed from the data that the straight pineapple RTS was significantly superior to the pineapple and pomegranate blended RTS with respect to the flavour. The treatment T1 i.e. straight pineapple RTS recorded the highest (7.58) sensory score for flavour of the product. The treatment T3 recorded the lowest (6.58) sensory score for flavour of the product.

Among the blends, the treatment T2 with 10 per cent pomegranate juice had more pineapple flavour than the rest of the blends. However, this treatment was at par with the treatment T5 with 40 per cent pomegranate juice. Thus, the blended RTS with 60:40 (pineapple:pomegranate) had more acrid taste of pomegranate and light pineapple flavour that might have liked by the sensory panel.

The organoleptic score for flavour of the blended RTS reduced significantly during storage, which was maximum (7.53) immediately after preparation, but decreased to a score of 6.37 after 90 days of storage.

The interaction between treatment and storage was found to be statistically non-significant. Similar observations were also reported by Marimuthu and Thirumaran (2000) and Das (2009) in jamun syrup and Shikhare (2014) in kokum sapota blended syrup and Kalunkhe *et al.* (2014) in lemon squash.

4.4.3 Overall acceptability

It is evident from the data presented in Table 13 and Fig. 10 that the changes in the organoleptic score for overall acceptability of blended RTS due to treatments were found statistically significant.

It is noticed from the data that the treatment T1 was significantly superior to the rest of treatments with respect to overall acceptability. The lowest (6.19) mean organoleptic score for overall acceptability of the product was recorded by the treatment T4, followed by the treatments T3 and T2. The treatments T2 and T5 were at par with each other. The straight pineapple RTS was significantly superior to the pineapple:pomegranate blended RTS with respect to overall acceptability of the product.

It is evident from the data that the straight pineapple RTS product due to its intense pineapple flovour much liked by the panel and thereby it ranked first with highest overall acceptability score. Among the blends, the RTS with 40 per cent pomegranate was superior with respect to the overall acceptability to other blends except the blend with 10 per cent pomegranate juice.

In storage, the organoleptic score for overall acceptability of the RTS declined significantly i.e. from 7.55 to the score of 6.42

after 90 days of storage. The interaction effects between treatment and storage were found statistically non-significant.

Analogous observations in conformity to these finding were also reported by Marimuthu and Thirumaran (2000) in jamun syrup and Shikhare (2014) in kokum sapota blended syrup and Lad *et al.* (2013) in lime cv. saisarbati squash.

4.5 Economics

The economics for the preparation of 100 kg of blended RTS is given in Table 15. From the results, it could be observed that the total expenditure for production of blended RTS was highest (Rs.6791.29) in the treatment T5 i.e. 60:40 (pineapple: pomegranate) and lowest (Rs. 6630) in T1 i.e straight pineapple RTS

Higher gross returns and net profit of Rs. 8149.54 and Rs. 1358.25, respectively was found in the treatment T5 i.e. 60:40 (pineapple: pomegranate) and lowest gross returns (Rs. 7956.8) and net profit (Rs. 1326.13) in T1 i.e straight pineapple RTS. The sale price was maximum (Rs16.29) in T5[60:40] (pineapple: pomegranate) and lowest (Rs. 15.91) in the treatment T1 (straight pineapple RTS). The benefit cost ratio (1.20) was same in all seven treatments, as the profit margin was considered as 20 per cent to each treatment.

According to the sensory qualities for overall acceptability, the treatment recipe T5 (60 pineapple: 40 pomegranate) was superior to other blends and recorded the highest gross returns on the

investment. The Sale price of blended RTS in the treatment T5 was Rs. 16.29 per 200 ml.

CHAPTER V

SUMMARY AND CONCLUSION

The research project entitled "Studies on preparation of blended pineapple (Ananas *comosus* L.) pomegranate *(Punica granatum)* RTS" was undertaken 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 2015-2016.

The pivotal findings of the present investigation are summarised and mentioned as below.

5.1 Per cent juice recovery of pineapple and pomegranate

The average juice recovery of pineapple and pomegranate was 49.38 and 43.0 per cent, respectively.

5.2 Chemical composition of fruit juices

The T.S.S and titratable acidity of pineapple fruit juice was 12.5° brix and 0.56 per cent, respectively. The reducing and total sugars of pineapple fruit juice were 3.86 and 9.18 per cent, respectively

The pomegranate juice had 16.2°brix T.S.S with 0.38 per cent titratable acidity. The reducing sugars and total sugars in the pomegranate juice were 13.4 and 15.01 per cent, respectively.

5.3. Changes in the physical and chemical composition of blended RTS

5.3.1 Physical parameters of blended RTS

5.3.1.1 L* Value for colour

The treatment T1 i.e. straight pineapple RTS recorded the highest (82.34) mean L* value for colour. The lowest (74.74) mean L* value for colour was observed in the treatment T5 i.e. 60:40 ratio of pineapple:pomegranate juice in the RTS.

The decreasing trend was seen up to 90 days of storage. The highest (82.54) mean colour L* value was recorded at 0 day of storage and the lowest (76.32) at 90 days of storage.

5.3.1.2 a* value for colour

The treatment T5 i.e. (60 pineapple juice: 40 pomegranate juice) recorded the highest (5.23) mean a* value for colour. The lowest (2.28) mean a* value for colour was observed in the treatment T2 (90 pineapple: 10 pomegranate), but at par with the treatment T1.

The increasing trend was seen up to 90 days of storage. The highest (4.43) mean a* value for colour was recorded at 90 days of storage and the lowest (2.48) was observed initially at the time of preparation of the blended RTS.

5.3.1.3 b* value for colour

The treatment T5 i.e. 60:40 (pineapple:pomegranate) recorded the highest (3.23) mean b* value for colour. The lowest (-3.63) mean b* value for colour was observed in the treatment T1 i.e. Straight pineapple RTS. The increasing trend was seen up to 90 days of storage. The highest mean (3.23) b* value for colour was recorded at 90 days of storage and the lowest (-1.45) mean b* value for colour was observed at 0 days of storage.

5.3.2 Chemical composition of blended RTS

The changes in the chemical constituents of blended RTS were observed during the storage period of 90 days as given below.

1. As regards the total soluble solids (T.S.S.), the treatment T-1 i.e. 100:00 (pineapple: pomegranate) recorded maximum (10.33° B) mean T.S.S. while it was minimum (10.07^0 B) in the treatment T-5 (60:40). A significant increase in the T.S.S. of RTS was noticed throughout the storage period of 90 days.
2. Considering the acidity of blended RTS, it was also increased with the advancement of the storage period. The highest (0.307%) mean titratable acidity was recorded in the treatment T5 i.e. 90:10 and 60:40 (pineapple:pomegranate) and the lowest acidity i.e. 0.299% per cent was recorded in the treatment T1.
3. As far as reducing sugar content in blended RTS is concerned, the treatment T5 i.e 60:40 (pineapple:pomegranate) recorded significantly highest (5.08%) reducing sugars and lowest (3.61%) in the treatment T1 i.e straight pineapple RTS. There was an increase in the reducing sugar content of RTS irrespective of treatments during storage.
4. Total sugar content of blended RTS exhibited variation due to the treatments and increased significantly during the storage. The maximum (8.87%) total sugar content was recorded in treatment T-5 i.e. 60:40 (pineapple:pomegranate), but at par with the treatment T4 The minimum (7.58%) total sugar content was noticed in the treatment T1 i.e. straight pineapple RTS.

Thus, an increasing trend in T.S.S, acidity, reducing sugars and total sugars was observed during storage period of 90 days.

5.4 Microbial analysis of blended RTS

The microbial analysis for bacteria as well as for fungi in blended RTS was carried out during storage, however, the microbial growth in pineapple:pomegranate blended RTS was not observed during storage and the product was totally free from bacteria as well as fungi throughout the storage period of 90 days.

5.5 Changes in organoleptic qualities of blended RTS

The blended RTS prepared from pineapple and pomegranate juice was organoleptically acceptable up to 90 days of storage.

Among different recipes, the treatment T1 i.e. 100:00 (pineapple:pomegranate) recorded maximum (7.75, 7.58 and 7.56, respectively) mean score for colour, flavour, and overall acceptability of the blended RTS. The organoleptic score of blended RTS was decreased irrespective of the treatments throughout the storage period of 90 days. Among all the recipes, the RTS recipes i.e 100:00 (pineapple:pomegranate) was found to be superior in organoleptic qualities to all other recipes . However, among the blends, the RTS with 40 per cent pomegranate was superior with respect to the overall acceptability to other blends except the blend with 10 per cent pomegranate juice.

5.6 Economics of the blended RTS

As far as the economics of blended RTS is concerned, among all the treatments, the treatment T-1 i.e. straight pineapple RTS recorded the lowest sale price i.e. Rs. 15.91 and highest in the treatment T-5 (Rs.16.29).

From organoleptic point of view, the treatments T1 was the best treatment. The treatment T1 i.e. 100:00 (pineapple:pomegranate) recorded the lower sale price than the other treatments. However, among the blends, the treatment T5 was superior to other blends and recorded highest gross returns (Rs 8154.49) and net profit (Rs 1358.25).

CONCLUSION

From the present investigation, it could be concluded that, all the recipes of blended RTS were found to be organoleptically acceptable not only at the time of preparation but also throughout the storage period of 3 months at ambient conditions.

A decreasing trend in L* value with increased a* and b* value for colour of the blended RTS was noticed during storage. As regards chemical composition, all chemical parameters like TSS, titrable acidity, reducing and total sugars of the product exhibited an increasing trend during storage period of 90 days at ambient condition.

The straight pineapple RTS prepared from pineapple fruit juice was significantly superior with respect to overall acceptability of the product to the RTS prepared from pineapple and pomegranate juice.

The blended RTS recipe i.e. 60 per cent pineapple and 40 percent pomegranate blended RTS was found to be the best recipe for blended RTS with highest organoleptic score for colour, flavour and overall acceptability and higher gross returns and net profit on the investment.

Table 15: Cost of production of blended pineapple: pomegranate RTS (100 kg)

Sr. No.	Particulars	T1	T2	T3	T4	T5
1.	**Cost of pineapple fruits @ Rs.50/- per kg**	1012.5	911	810	708	607.5
2.	**Cost of pomegranate fruits @ Rs.60 /- per kg**	0.00	139.2	279	418	558
3.	**Labour charge @ Rs. 200/- per skilled and Rs. 120/- per unskilled Labour**	440	440	440	440	440
4.	**Glass bottle @ Rs. 5/- per bottle**	2500	2500	2500	2500	2500
5.	**Sugar @ Rs. 35/- per kg**	311.5	308.7	307.3	305.2	304.15
6.	**Citric acid @ Rs. 25.5/- per 100gm**	74.60	74.61	74.63	74.68	74.97
7.	**Sodium benzoate @ Rs.312/- per 500gm**	6.24	6.24	6.24	6.24	6.24
8.	**Plastic caps @ Rs. 50/- per 100 caps**	250	250	250	250	250
9.	**Fuel charge @ Rs. 8.33 per hr of the product**	69.41	69.41	69.41	69.41	69.41

	Cost of production					
1.	**Working capital**	4664.25	4699.16	4736.58	4771.53	4810.27
2.	**Supervision charges @ 10% of the working capital**	466.42	469.91	473.65	477.15	481.02
3.	**Depreciation charges @ 2% of the fixed capital @ 2 % on ` 10000**	200	200	200	200	200

4.	**Interest on fixed capital@ 13 % on Rs. 10000/-**	1300	1300	1300	1300	1300
5.	**Total cost of production (A)**	6630.67	6669.07	6710.23	6748.68	6791.29
6.	**Gross returns (B)**	7956.8	8002.8	8052.27	8098.41	8149.54
7.	**Net profit (B-A) Rs.**	1326.13	1333.81	1342.04	1349.73	1358.25
8.	**Benefit : cost (B/A)**	1.2	1.2	1.2	1.2	1.2
9.	**Sale price per 200 ml bottle**	15.91	16.00	16.10	16.19	16.29

Table 1. Juice recovery and chemical composition of pineapple juice

Sr. No	Particulars	Mean*
A.	Juice recovery (%)	49.38
B.	Chemical parameters	
1.	T.S.S. (^{0}B)	12.5
2.	Titratable acidity (%)	0.56
3.	Reducing sugars (%)	3.86
4.	Total sugars (%)	9.18

* The values are the means of three observations.

Table 2. Chemical composition of Pomegranate juice

Sr. No	Particulars	Mean*
A.	Juice recovery (%)	43.0
B.	Chemical parameters	
1.	T.S.S. (^{0}B)	16.2
2.	Titratable acidity (%)	0.38
3.	Reducing sugars (%)	13.4
4.	Total sugars (%)	15.01

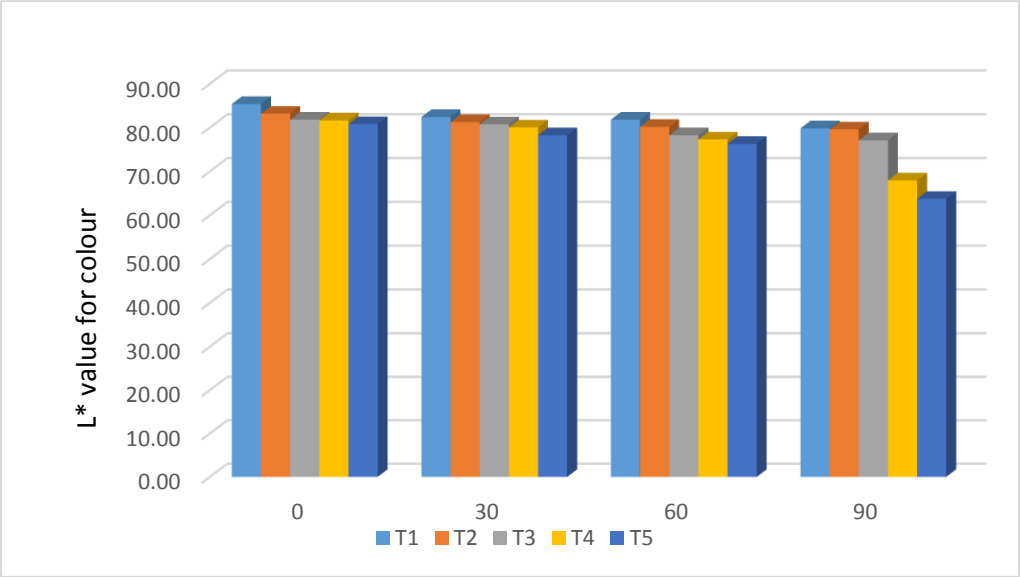
***** The values are the means of three observations.

Table 3. Changes in L* value for colour of pineapple: pomegranate blended RTS during storage at ambient condition

	L* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	85.36	82.39	81.8	79.81	82.34
T2	83.13	81.24	80.15	79.56	81.02
T3	81.80	80.73	78.23	77.09	79.46
T4	81.61	80.02	77.27	67.92	76.71
T5	80.77	78.22	76.25	63.71	74.74
Mean	82.54	80.52	78.14	73.62	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.25	0.70
Storage (S)	0.27	0.79
Interaction (TXS)	0.55	1.57

Fig.1. Changes in L* value for colour of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

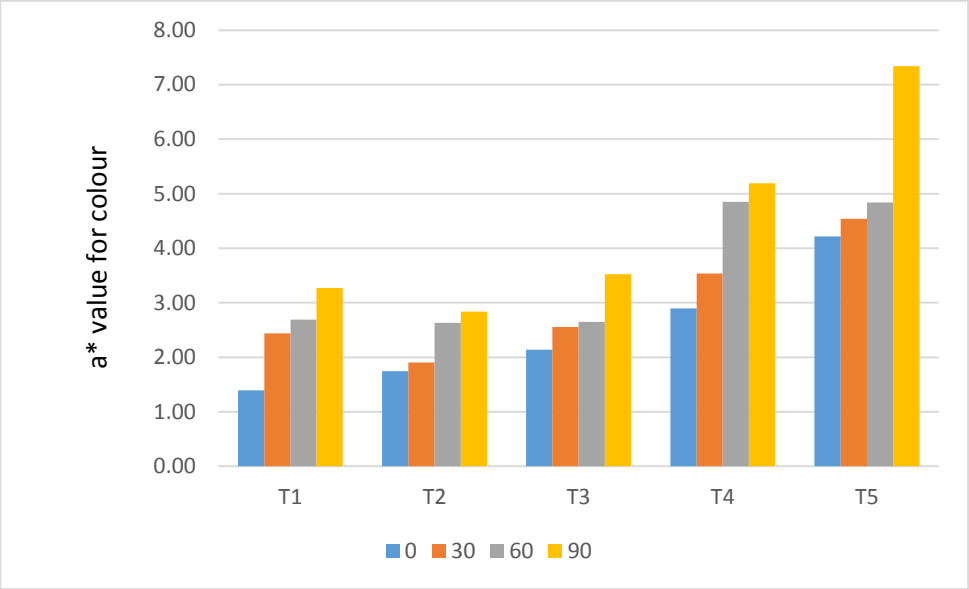
T5- 60:40
(Pineapple:Pomegranate)

Table 4. Changes in a* value for colour of Pineapple:Pomegranate blended RTS during storage at ambient condition

	a* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	1.39	2.44	2.69	3.27	2.45
T2	1.75	1.90	2.63	2.84	2.28
T3	2.14	2.55	2.65	3.52	2.72
T4	2.89	3.54	4.85	5.19	4.12
T5	4.22	4.54	4.84	7.34	5.23
Mean	2.48	3.00	3.53	4.43	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.07	0.20
Storage (S)	0.08	0.22
Interaction (TXS)	0.16	0.46

Fig. 2. Changes in a* value for colour of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

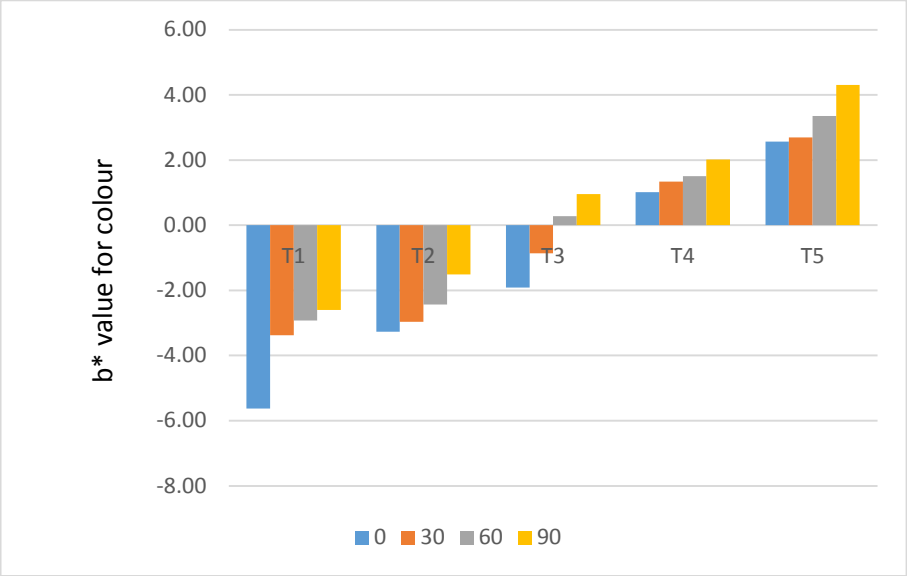
T5- 60:40
(Pineapple:Pomegranate)

Table 5. Changes in b* value for colour of pineapple:pomegranate blended RTS during storage at ambient condition

	b* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	-5.83	-3.37	-2.92	-2.50	-3.63
T2	-3.27	-2.96	-2.44	-1.50	-2.54
T3	-1.92	-0.86	0.28	0.96	-0.39
T4	1.02	1.34	1.51	2.01	1.47
T5	2.56	2.70	3.36	4.31	3.23
Mean	-1.45	-0.60	-0.04	3.23	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.13	0.36
Storage (S)	o.14	0.41
Interaction (TXS)	0.28	0.81

Fig. 3. Changes in b* value for colour of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

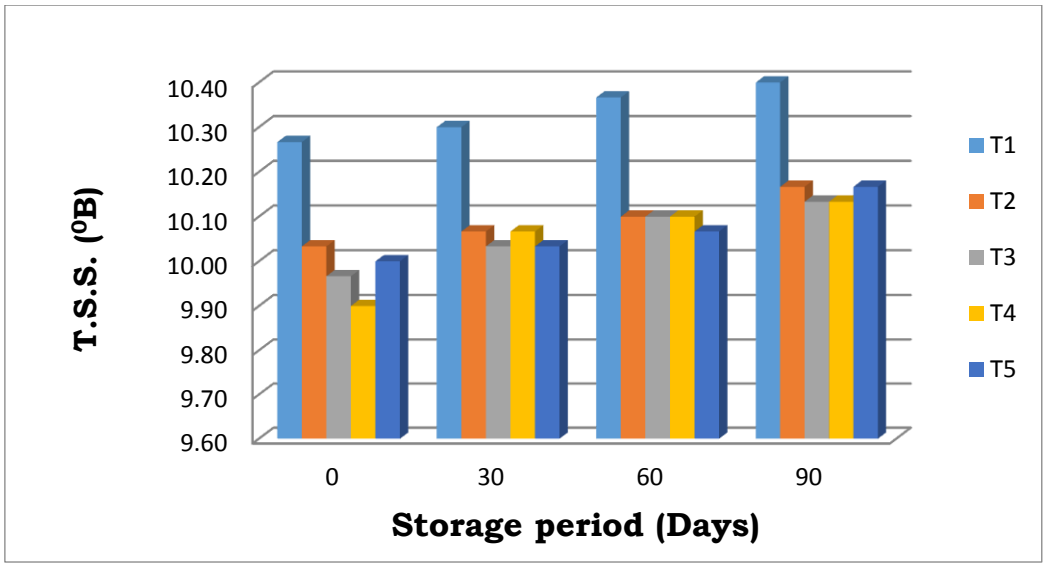
T5- 60:40
(Pineapple:Pomegranate)

Table 6. Changes in T.S.S. of pineapple:pomegranate blended RTS during storage at ambient condition

	TSS (^{0}B)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	10.27	10.30	10.36	10.40	10.33
T2	10.03	10.06	10.10	10.16	10.09
T3	9.97	10.03	10.10	10.13	10.06
T4	9.90	10.07	10.10	10.13	10.05
T5	10.00	10.03	10.07	10.17	10.07
Mean	10.03	10.10	10.15	10.20	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.04	0.13
Storage (S)	0.05	0.14
Interaction (TXS)	0.10	N.S.

Fig. 4. Changes in T.S.S. of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

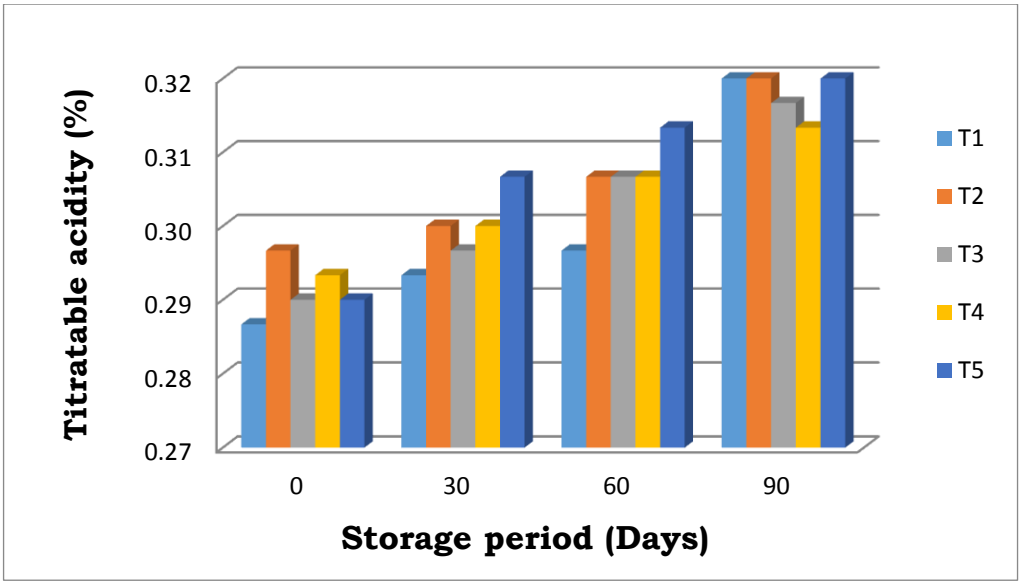
T5- 60:40
(Pineapple:Pomegranate)

Table 7. Changes in titratable acidity of pineapple:pomegranate blended RTS during storage at ambient condition

	Titratable acidity (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	0.29	0.29	0.30	0.30	0.299
T2	0.30	0.30	0.31	0.32	0.305
T3	0.29	0.30	0.30	0.32	0.302
T4	0.29	0.30	0.31	0.31	0.303
T5	0.29	0.31	0.31	0.32	0.307
Mean	0.29	0.30	0.31	0.32	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.0019	0.0055
Storage (S)	0.0021	0.006
Interaction (TXS)	0.0043	N.S.

Fig. 5. Changes in titratable acidity of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

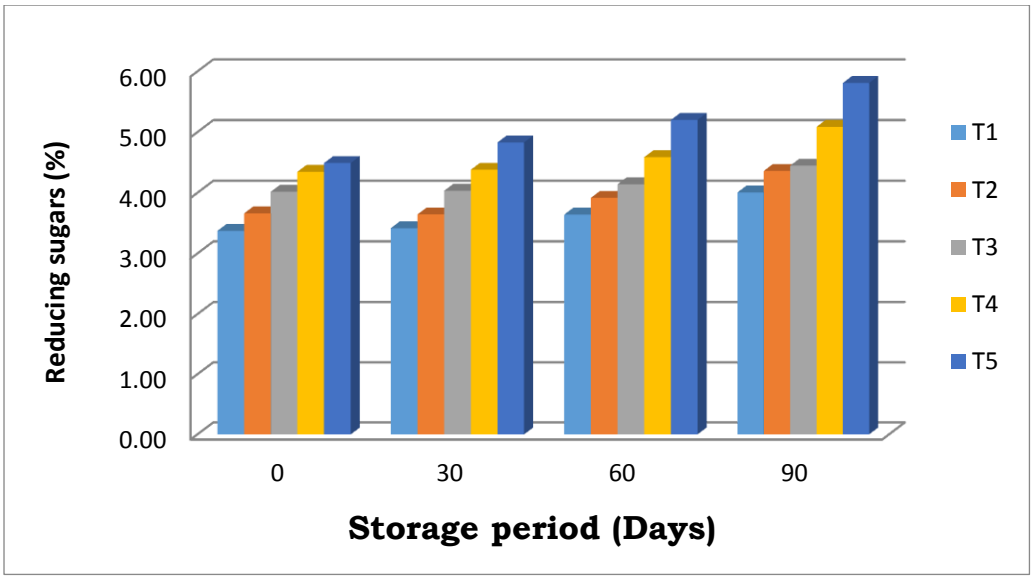
T5- 60:40
(Pineapple:Pomegranate)

Table 8. Changes in reducing sugars of pineapple:pomegranate blended RTS during storage at ambient condition

	Reducing sugars (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	3.37	3.42	3.64	4.01	3.61
T2	3.66	3.64	3.92	4.36	3.90
T3	4.02	4.03	4.14	4.45	4.16
T4	4.35	4.38	4.59	5.09	4.60
T5	4.49	4.83	5.20	5.81	5.08
Mean	3.98	4.06	4.30	5.08	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.083	0.23
Storage (S)	0.092	0.26
Interaction (TXS)	0.18	N.S.

Fig. 6. Changes in reducing sugars of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

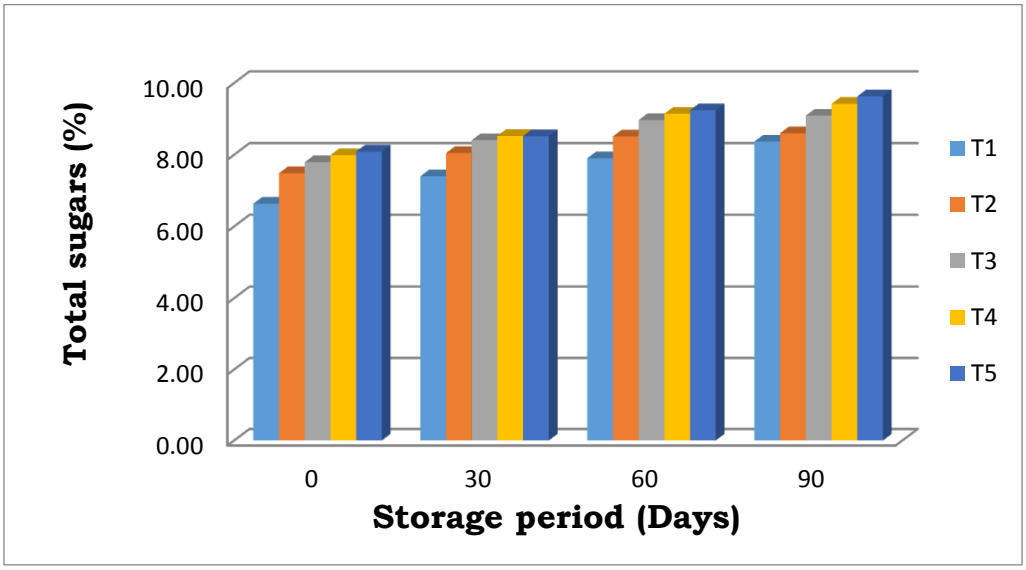
T5- 60:40
(Pineapple:Pomegranate)

Table 9. Changes in total sugars of pineapple:pomegranate blended RTS during storage at ambient condition

	Total sugars (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	6.64	7.40	7.90	8.37	7.58
T2	7.49	8.04	8.51	8.6	8.16
T3	7.79	8.41	8.96	9.09	8.56
T4	7.99	8.53	9.14	9.42	8.77
T5	8.08	8.52	9.24	9.63	8.87
Mean	7.60	8.18	8.75	9.02	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.059	0.17
Storage (S)	0.066	0.19
Interaction (TXS)	0.13	N.S.

Fig. 7. Changes in total sugars of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

T5- 60:40
(Pineapple:Pomegranate)

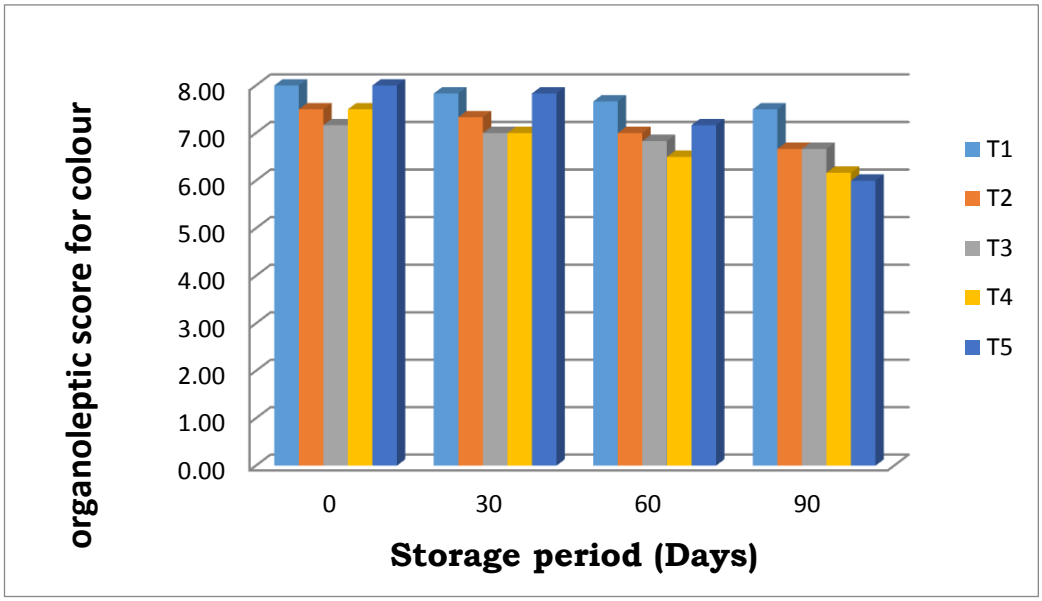
Table 11. Changes in the organoleptic score for colour of pineapple:pomegranate blended RTS during storage at ambient condition

	Organoleptic score for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	8.00	7.83	7.66	7.50	7.75
T2	7.50	7.33	7.00	6.67	7.13
T3	7.17	7.00	6.83	6.67	6.92
T4	7.50	7.00	6.5	6.17	6.79
T5	8.00	7.83	7.17	6.00	7.25
Mean	7.63	7.40	7.03	6.60	

	S.E.m ±	C.D. at 5 %

Treatment (T)	0.066	0.19
Storage (S)	0.074	0.21
Interaction (TXS)	0.14	0.42

Fig. 8. Changes in the organoleptic score for colour of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00
(Pineapple:Pomegranate)

T2- 90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

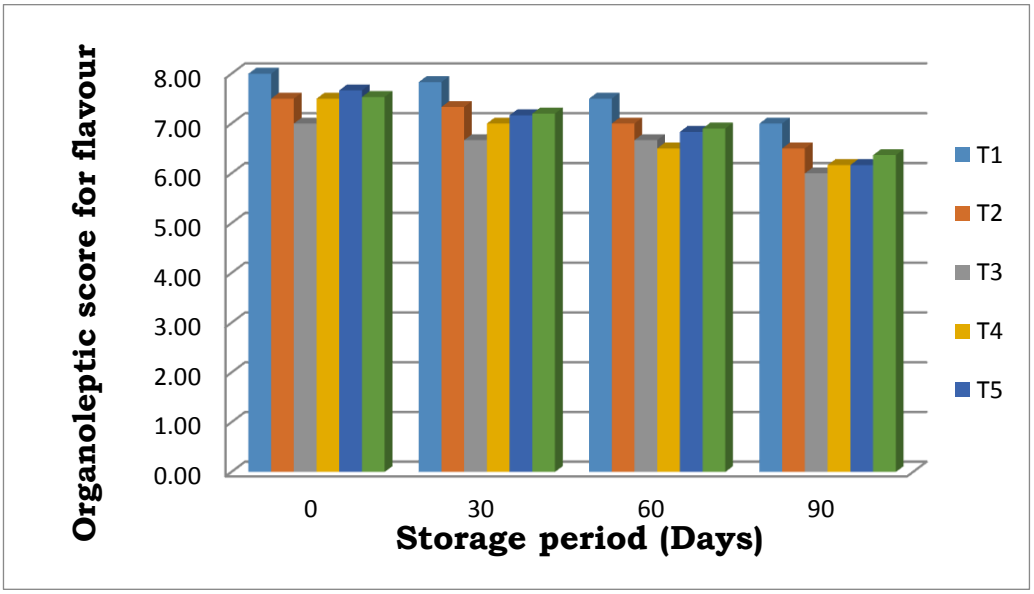
T5- 60:40
(Pineapple:Pomegranate)

Table 12. Changes in the organoleptic score for flavour of pineapple:pomegranate blended RTS during storage at ambient condition

	Organoleptic score for flavour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	8.00	7.83	7.50	7.00	7.58
T2	7.50	7.33	7.00	6.50	7.08
T3	7.00	6.67	6.66	6.00	6.58
T4	7.50	7.00	6.50	6.17	6.79
T5	7.60	7.17	6.83	6.17	6.96
Mean	7.53	7.20	6.90	6.37	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.05	0.16
Storage (S)	0.06	0.18
Interaction (TXS)	0.13	N.S.

Fig. 9. Changes in the organoleptic score for flavour of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00 (Pineapple:Pomegranate)

T2- 90:10 (Pineapple:Pomegranate)

T3- 80:20 (Pineapple:Pomegranate)

T4- 70:30 (Pineapple:Pomegranate)

T5- 60:40 (Pineapple:Pomegranate)

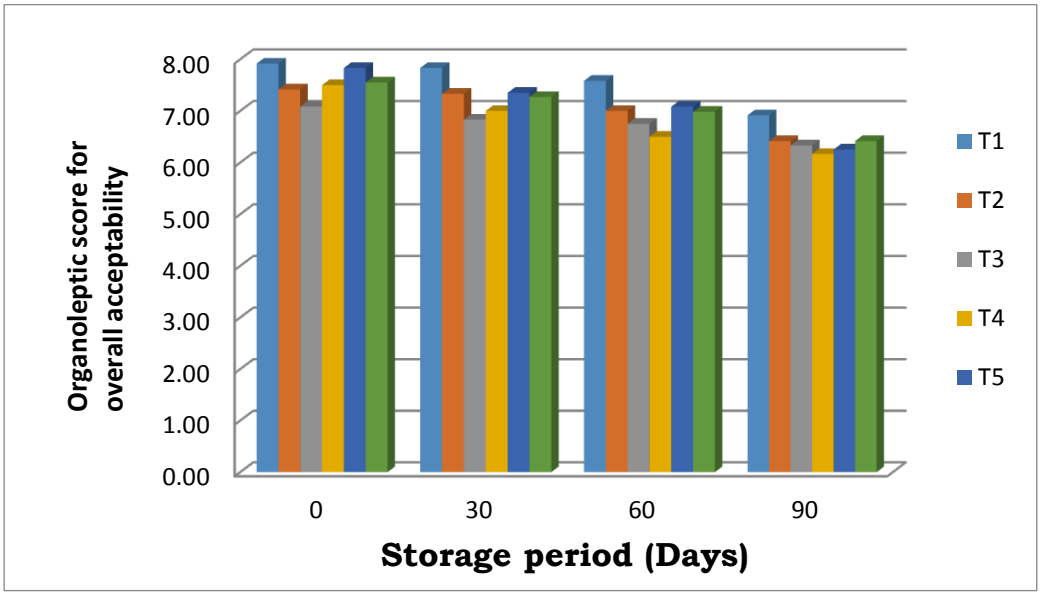
Table 13. Changes in the organoleptic score for overall acceptability of pineapple:pomegranate blended RTS during storage at ambient condition

	Organoleptic score for overall acceptability				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**

T1	7.92	7.83	7.58	6.92	7.56
T2	7.41	7.33	7.00	6.41	7.04
T3	7.08	6.83	6.75	6.33	6.75
T4	7.50	7.00	6.50	6.17	6.19
T5	7.83	7.35	7.08	6.25	7.13
Mean	7.55	7.27	6.98	6.42	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.06	0.17
Storage (S)	0.07	0.19
Interaction (TXS)	0.13	N.S.

Fig. 10. Changes in the organoleptic score for overall acceptability of pineapple:pomegranate blended RTS during storage at ambient condition



T1- 100:00 (Pineapple:Pomegranate)

T2- 90:10 (Pineapple:Pomegranate)

T3- 80:20 (Pineapple:Pomegranate)

T4- 70:30 (Pineapple:Pomegranate)

T5- 60:40 (Pineapple:Pomegranate)

Table 10. Changes in microbial count of pineapple:pomegranate blended RTS during storage at ambient condition

	Microbial count (cfu/ml)		
Treatments	**Storage period (Days)**		
	0	**90**	**Mean**
T1	Nil	Nil	Nil
T2	Nil	Nil	Nil
T3	Nil	Nil	Nil
T4	Nil	Nil	Nil
T5	Nil	Nil	Nil

Mean	Nil	Nil	Nil

	S.E.m ±	C.D. at 5 %
Treatment (T)	Nil	Nil
Storage (S)	Nil	Nil
Interaction (TXS)	Nil	Nil

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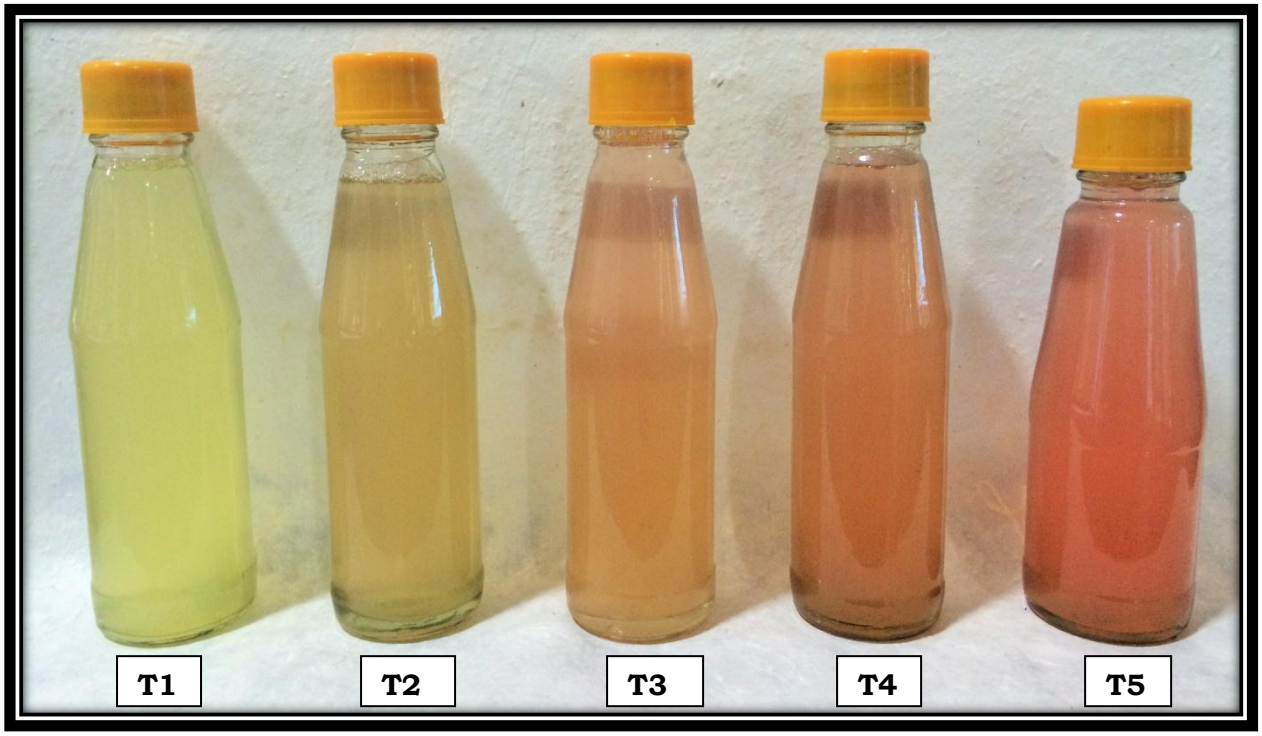
Plate no.1

Pineapple: pomegranate blended RTS during 0 day storage



T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

T5- 60:40
(Pineapple:Pomegranate)

Plate no.2

Pineapple: pomegranate blended RTS during 30 days storage

T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

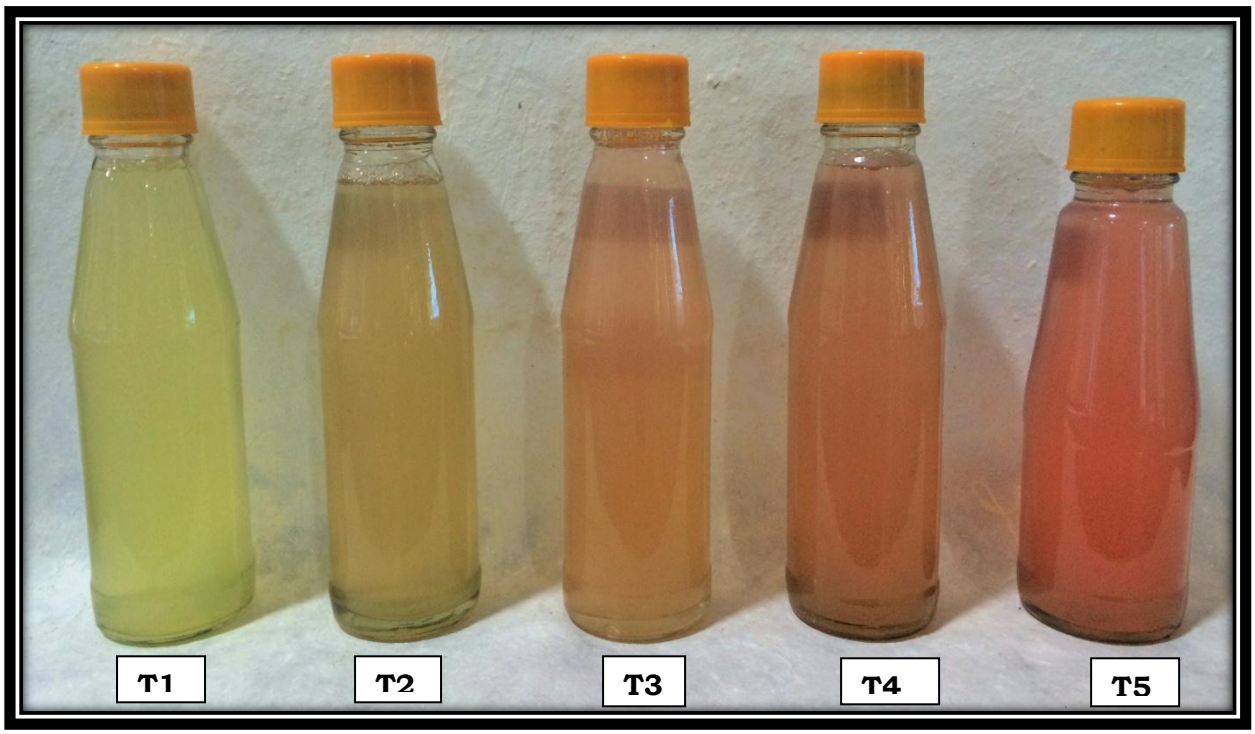
T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

T5- 60:40
(Pineapple:Pomegranate)

Plate no.3

Pineapple: pomegranate blended RTS during 60 days storage



T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

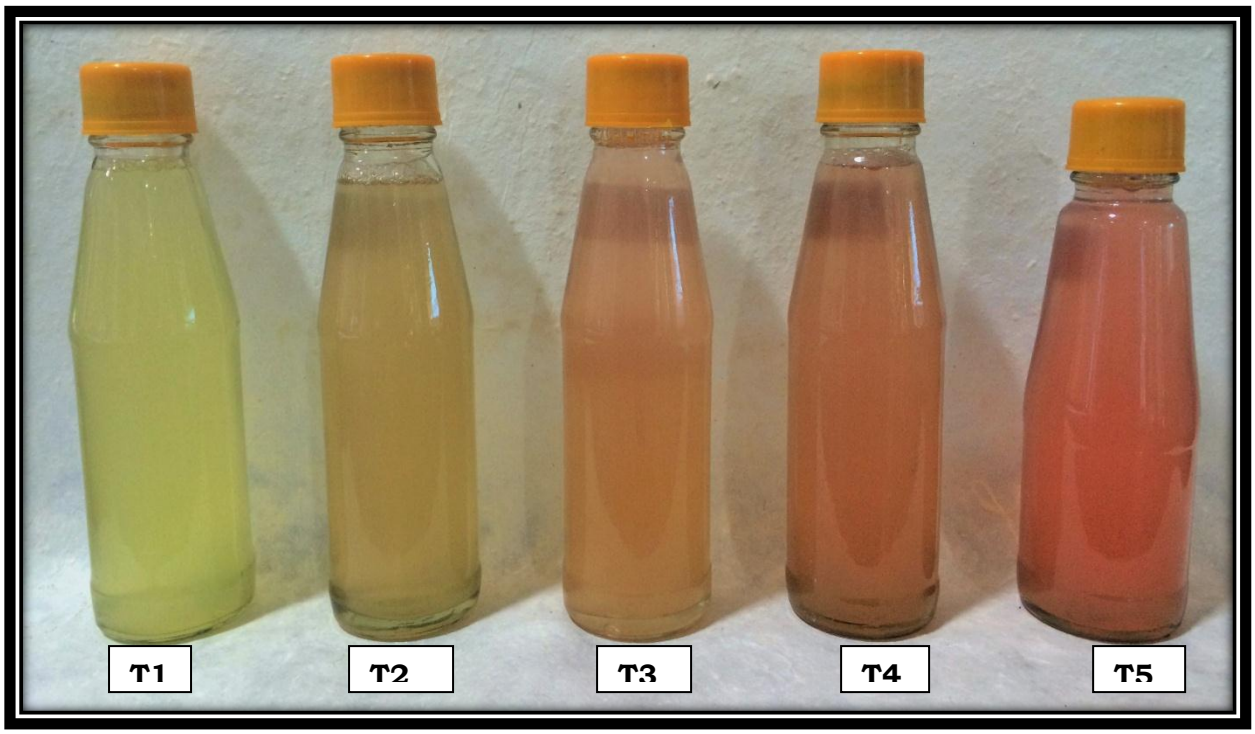
T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

T5- 60:40
(Pineapple:Pomegranate)

Plate no.4

Pineapple: pomegranate blended RTS during 90 days storage



T1- 100:00
(Pineapple:Pomegranate)

T2-90:10
(Pineapple:Pomegranate)

T3- 80:20
(Pineapple:Pomegranate)

T4- 70:30
(Pineapple:Pomegranate)

T5- 60:40
(Pineapple:Pomegranate)