"STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.) MANGO (*Mangifera indica* L.) CRUSH"

By

GOVIND MAHESH CHAVAN.

B.Sc. (Horti.)

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

FACULTY OF POST HARVEST MANAGEMENT,

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH,

DAPOLI - 415 712, DIST. RATNAGIRI (M.S.)

July, 2015

"STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.) MANGO (*Mangifera indica* L.) CRUSH"

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

FRUIT, VEGETABLE AND FLOWER CROPS

by

Mr. GOVIND MAHESH CHAVAN.
B.Sc. (Horti.)

DEPARTMENT OF FRUIT, VEGETABLE AND FLOWER CROPS

FACULTY OF POST HARVEST MANAGEMENT

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH,

DAPOLI - 415 712, DIST. RATNAGIRI (M.S.)

July, 2015

Dr. P. P. Relekar

M.Sc. (Agri.), Ph.D. (Hort.)
Associate Professor
P.G. Institute of Post Harvest Management
Killa-Roha. Dist-Raigad (M.S.)

CERTIFICATE

This is to certify that the thesis entitled **" STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.) MANGO (*Mangifera indica* L.) CRUSH"** *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. GOVIND MAHESH CHAVAN** *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.*

Place: Killa-Roha
Date: July , 2015

(Dr. P. P. Relekar)
Chairman,
Advisory Committee
and
Research Guide

" STUDIES ON PREPARATION OF BLENDED PINEAPPLE (*Ananas comosus* L.) MANGO (*Mangifera indica* L.) CRUSH"

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

FRUIT, VEGETABLE AND FLOWER CROPS

by

Mr. GOVIND MAHESH CHAVAN.

B.Sc. (Horti.)

Approved by the Advisory Committee

: Chairman and Research Guide:

(Dr. P. P. Relekar)
Associate professor,
P. G. I. P. H. M. Killa, Roha,
Dist. Raigad.

: Members:

(Dr. K. H. Pujari)
Associate Dean,
P. G. I. P. H. M. Killa, Roha,
Dist. Raigad.

(Dr. N. B. Gokhale)
Incharge, Plant Biotechnology,
Dr. B.S.K.K.V, Dapoli.

CANDIDATE'S DECLARATION

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

Place: Roha-killa **(G. M. Chavan.)**
Date: / / 2015

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. B. Venkateswarlu,*** *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. Shedge Sir, Mr. Nadkarni Sir, Mr. Khaple 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 ***Roshan, Sanket, Mayuresh****, Abhishek , Hemant, Akash, Suhas, Mita, Harshala, Priyanka, Yugandhara, Rupali, Priyanka, and other colleagues for their helping and kind co-operation during the course of study.*

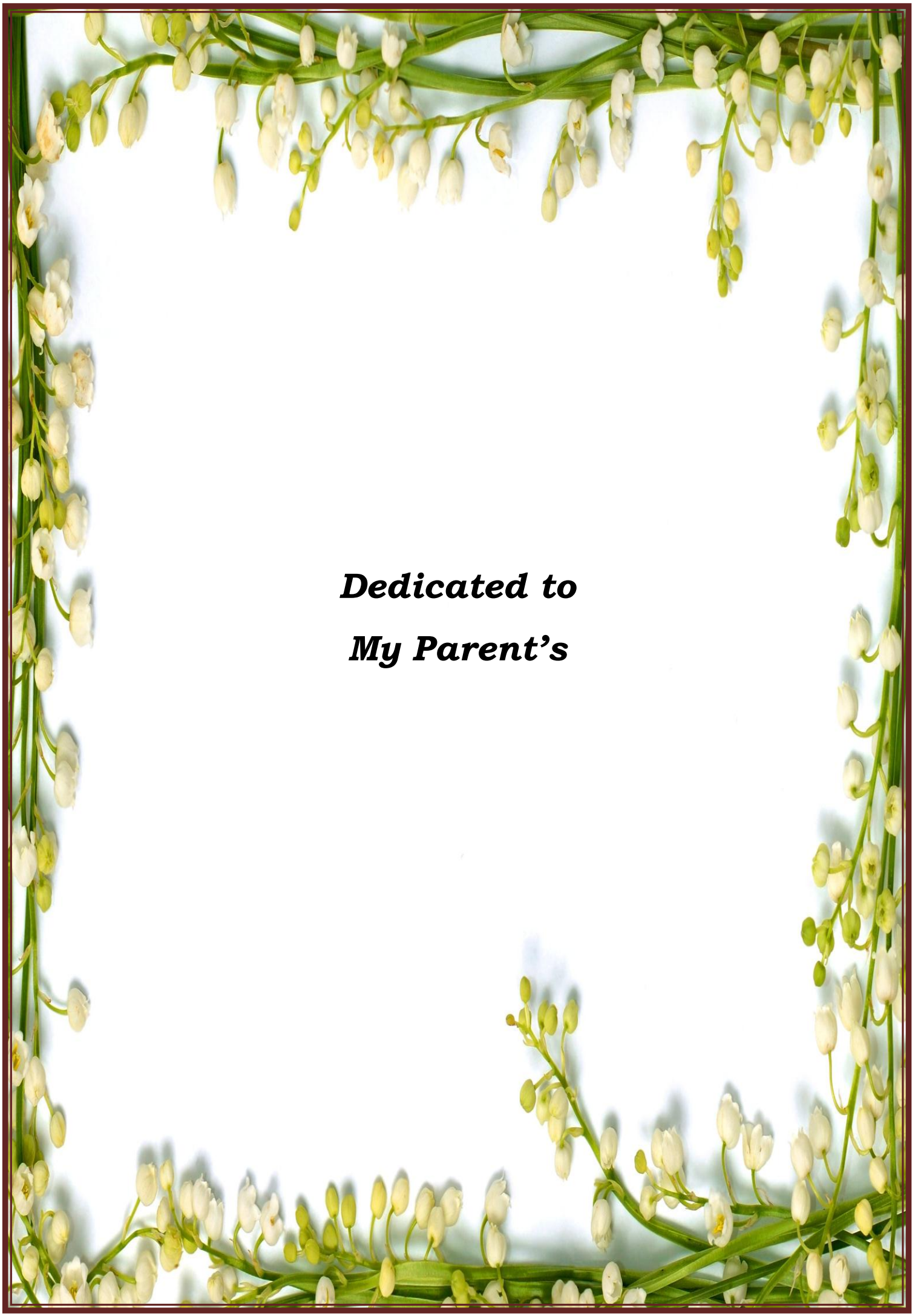
It is friends who share your secret, who provides crutches to crumbling house of confidence and remembrance. I am greatful to god for giving me friends like Ashish, Sahil, Navdeep, Jagdish and my dear brother Mr. Vishal Mahesh Chavan and Mr. Sagar Mahesh Chavan for their kind co-operation and companionship.

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*: / / 2015*

(Govind Mahesh Chavan.)



Dedicated to

My Parent's

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FLOW SHEET

LIST OF PLATES

LIST OF FIGURES

APPENDIX I

Weekly Weather Data Dapoli Center Year, 2014

Period	Ambient storage conditions			
	Temperature (ºC)		Relative humidity (%)	
	Max.	Min.	Max.	Min.
1.02 - 7.02	22.9	16.9	94.0	89
8.02 - 14.02	23.6	18.4	93.1	87.6
15.02 - 21.02	25.7	17.4	90.6	86.1
22.02 - 28.02	23.3	17.9	88.0	84
1.03 - 7.03	26.0	19.3	85.4	81
8.03 - 14.03	27.6	20.7	81.7	77.0
15.03 - 21.03	31.9	23.1	86.6	61
22.03- 28.03	32.1	22.5	79.4	62
29.03 – 4.04	33.4	23.4	85.4	65
5.04 – 11.04	32.6	24.4	90.3	79
12.04 – 18.04	33.8	25.1	89.1	76
19.04 – 25.04	34.0	23.9	81.4	79.5
26.04 - 2.05	35.7	23.8	81.7	77.7
3.05 - 9.05	27.4	23.4	82.9	75.4

APPENDIX II

ABBREVIATIONS USED

%	:	per cent
(TxS)	:	Interaction of treatments and storages
/	:	Per
@	:	At the rate of
µ	:	Micron
^{0}Brix	:	Degree Brix
^{0}C	:	Degree Celsius
A.O.A.C.	:	Association of Official Analytical chemists
Anon.	:	Anonymous
C.D.	:	Critical difference
Cv.	:	Cultivar
et al.	:	and others
etc.	:	etcetera
FCRD	:	Factorial Completely Randomized Design
Fig.	:	Figure
g.	:	Gram (s)
Ha	:	Hectare
hrs.	:	Hours
i.e.	:	that is
IU	:	International Unit (s)
kg	:	Kilogram
M.S.	:	Maharashtra State.
mg	:	Milligram
min	:	minute
ml	:	Milliliter
mm	:	Millimeter
MT	:	Metric tonne

nm	:	Nano meter
NS	:	Non-significant
ppm	:	Parts per million
S.E.m	:	Standard error of mean
Sig.	:	Significant
T	:	Treatments
TSS	:	Total soluble solids
Viz.	:	Namely

VITAE

GOVIND MAHESH CHAVAN.

A candidate for the degree of

M.Sc. (Post Harvest Management)

Title of thesis	Studies on preparation of blended pineapple (*Ananas comosus* L.) mango (*Mangifera indica* L.) crush
Major Field	Post Harvest Management Of Fruit Vegetable and Flower Crops.

Biographical Information

-Personal data	Born at Mumbai on March 30, 1992., Unmarried. Son of shri. Mahesh Vitthal Chavan.
-Education	Attended secondary school at Y.C.S Vidyamandir ,Bhandup.Higher secondary school at Navjeevan college ,Bhandup,Received the Bachelor's Degree in Agriculture in First class, From the College Of Agriculture, Dapoli ,Dist-Ratnagiri, in 2013.

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

POST GRADUATE INSTITUTE OF POST HARVEST MANAGEMENT

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH, DAPOLI

Title of thesis	**:**	Studies on preparation of blended pineapple (*Ananas comosus* L.) mango (*Mangifera indica* L.) crush.
Name	**:**	Mr. Govind Mahesh Chavan.
Regd. No	**:**	PHMRM-1382
Degree	**:**	M.Sc. (P.H.M.)
Name and designation of Research Guide	**:**	Dr. P.P. Relekar Associate Professor, P. G. Institute of Post Harvest Management, Killa, Roha. Dist. Raigad.

ABSTRACT

The present research work entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.) mango (*Mangifera indica* L.) crush" 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 2014-2015.

The experiment on preparation of pineapple:mango blended crush was laid out with seven 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 and total sugars increased with decrease in the acidity content during storage of 90 days.

Among all the crush recipes i.e. 50:50 (pineapple:mango) was found to be the best recipe for blended crush with highest organoleptic score for colour, flavour and overall acceptability and higher gross returns on the investment. For the preparation of pineapple crush, mango pulp could used as a stabilizer in 50:50 proportion for uniform dispersion of colloidal particles in the product.

CHAPTER I
INTRODUCTION

India is blessed by varied agro climatic conditions which have paved a way to grow 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, the pineapple (*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 resembles a 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 vit A, 0.079 mg vitamin B1, 0.031 mg vitamin B2, 24 mg ascorbic acid, and gives 52 calories of energy (Farid Hossain *et al.*, 2015).

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 state are Assam (2,16,100 tonnes), West Bengal (2,79,500 tonne), Kerala (84,600 tons), Meghalaya (81,700 tonnes) and Karnataka

(81,193 tonnes) (Rashmi *et al.*, 2005). 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. Assam, Meghalaya, Tripura, Manipur, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra are the major pineapple producing states of India (Anon.; 2003). It occupies an area of about 85.4 thousand ha with the production of 1.35 million MT in India and 400 ha with production of 900 MT in Maharashtra (Anon.; 2007).

In Maharashtra, 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). Pineapple is a tropical fruit and hence is luscious, juicy and pulpy. It cannot be plucked early, cold-stored or subjected to controlled and long drawn out process as is possible in the case of fruits grown in temperate or colder regions. Fresh pineapples are fragile easily damaged and has relatively shorter shelf life. The challenge of the producer has always been to find ways to preserve food in a high quality state until it reaches the consumer. 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. A very fine fibre is extracted from its leaves for making light but stiff fabric called pina cloth.

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 .

Mango (*Mangifera indica* L.) is known as 'the king of fruits' due to its exotic flavour, delicious taste and several other desirable characters. Mango, the national fruit of India is the most popular tropical fruit crop belongs to Anacardiacae family originated from South Asia, the Indo-Burma region. It has intimate association with cultural, religious, aesthetic and economic life of Indians since time immemorial (Chattopadhyay, 1976). Mango (*Mangifera indica* L.) is the national fruit of India and since long, it is the choicest fruit in India and abroad. This fruit has been in cultivation in Indian continent for well over 4000 years and has been the favourite of the kings and commoners because of its nutritive value, taste, attractive fragrance and health promoting qualities and now, it is recognized as one of the best fruits in the world market. Mango is not only delicious, but also has fine taste and good qualities. It is fifth most widely produced fruits crop in the world after banana, citrus, grape and apple.

India is the largest producer of mango accounting for about 54 per cent of the world production, followed by Mexico, Pakistan, and Indonesia. In India, mango occupies about 37.60 per cent of an area and contributes 22.21 per cent of total production of fruit crops. The latest production of mango is 150.27 lakh tonnes. The major mango producing states are Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Tamil Nadu, West Bengal and Maharashtra (Anon.; 2010a). In Maharashtra state, currently mango crop has occupied the area of 4.82 lakh ha which is 19.28% of total area with a total production of over 6.33 lakh tonnes i.e 3.5% of country's mango production. (Anon.; 2013).

Alphonso is one of the leading mango cultivars of the Konkan region of Maharashtra. Konkan region accounts for only 10 per cent of the area under mango in whole country, out of which, almost 90 per cent area is covered by cv. Alphonso only with a major export share to the tune of over 35 per cent. The warm and humid climate throughout the year and rain free season from November to May prevalent in the Konkan region is ideal for mango in general and Alphonso in particular.

Mango is not only delicious but also has full nutritional value. It is high in beta-carotene, a precursor of vitamin A and is a rich source of the vitamin C. The ripe mangoes are reported to have 83.46 - 86.70 g moisture, 0.82 g protein, 0.38 g fat, 14.98 g carbohydrate, 11 mg calcium, 14 mg phosphorus, 0.16 mg iron, 0.135 - 1.872 IU vitamin A, 0.038 g riboflavin and 36.4 mg ascorbic acid per 100 g with 12.0-23.0 °Brix TSS and 0.12-0.38 per cent acidity (Anon.; 2010 b).

Mango being a highly perishable fruit possesses a very short shelf life and reach to respiration peak of ripening process on 3rd or 4th day after harvesting at ambient temperature (Narayana *et al.*, 1996). Mango fruits are generally liked by majority of the people from all age groups. But, the mango is a seasonal crop, hence, fruits are available only during specific season. Therefore, converting mango into different value added products is a must to avoid wastage and to increase its availability throughout the year. Attempts have been made to preserve fruits by using different methods such as canning, freezing, drying, etc.

Fruit crush is an important beverage which is intermediate between syrup and squash. The pineapple can be used for the preparation of crush. However, to improve the nutritive value and organoleptic qualities of the pineapple crush, it can suitably be

blended with the mango pulp. The present research work was, therefore, undertaken with the following objectives.

1) To standardize the recipe of pineapple mango blended crush

2) To study the storage behaviour of pineapple mango blended crush at ambient conditions

CHAPTER – II

REVIEW OF LITERATURE

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

2.1 Juice recovery of pineapple and other fruits

2.2 Chemical composition of fresh pineapple and mango pulp

2.3 Preparation of blended crush

2.4 Physical parameters of blended crush

2.5 Changes in chemical composition of blended crush during storage

2.6 Sensory evaluation of blended crush

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.

Nawale (1987) reported that the juice content in different cashew apple types was ranged from 44.43 to 77.90 per cent.

Sonkar and Ladaniya (1995) reported that the juice yield of nagpur mandarin juices 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) reported that the average juice recovery of sapota fruit was 36.5 per cent.

2.2 Chemical composition of fresh pineapple and mango pulp

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

Pruthi and Lal (1955) reported 13.32, 10.32, 12.42, 12.32, 18.68 and 8.30 Brix T.S.S. in pineapple, nagpuri orange, sathgudi orange, apple, grape and kagzi lime juice, respectively.

Sondhi (1962) reported the range of variation of T.S.S. from 17.2 to 18.30 Brix in detailed studies of physico-chemical composition of cashew apple juice.

Nanjundaswamy *et al.* (1966) reported that the total soluble solids in mango pulp ranged from 11.5 to 26.0 per cent.

Krishna *et al.* (1969) observed that the T.S.S. of 'Bhokri' and Beauty seedless grape juice was 11.8 and 18.40 Brix, respectively.

Satyavati *et al.* (1972) found the variation in total soluble solids between 10 ^{0}B and 20.4 ^{0}B, while studying different mango varieties.

Khurdiya and Anand (1981) studied the physico-chemical constituents of phalsa juice and recorded its T.S.S. as 29.90 Brix.

Vilasachandran and Damodaran (1984) reported 12.80 per cent T.S.S. in cashew apple juice.

Khurdiya and Roy (1985) studied the quality of juice of jamun extracted by different methods and recorded the T.S.S. of juices in the range of 2.5 to 9.0 per cent. They also studied the effect of temperature on extraction and quality of rose apple juice. By method of grating, juice with a T.S.S. of 10.00 Brix was obtained at 90^{0}C while juice with T.S.S. of 8.0^0 Brix was obtained by method of pulping when extracted at the temperature of 80^0 or 90^0 C.

Gole (1986) observed that at mature stage, seedling mango recorded the maximum T.S.S, (8.6%), followed by Alphanso (8.4%) and Pairi (8.1 %).

Anila and Radha (2003) studied the biochemical composition of Alphonso mango and observed that the mango contained 19.6 ^{0} Brix TSS, 17 per cent total sugars, 2.43 per cent reducing sugars, with 0.41 per cent acidity.

Mannan *et al.* (2003) recorded highest TSS (18.66 ^{0}B) in cv. Madrazi Tota mango fruits at ripe stage.

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

2.2.2. Titratable acidity

Pruthi and Lal (1955) studied the physico-chemical composition of some important Indian fruit juices and recorded a lot of variation in the acidity of different fruit juices such as purple passion fruit juice- 2.4 to 4.2 per cent; pineapple juice- 0.48 per cent; nagpuri orange juice- 0.44 per cent; apple juice- 0.52 per cent; grape juice- 1.01 per cent; kagzi lime juice- 0.79 per cent and tomato juice- 0.72 per cent.

Nanjudaswamy *et al.* (1966) found that the acidity of mango fruit ranged from 0.12 to 0.71 per cent.

Krishna *et al.* (1969) recorded the acidity of grape juice of variety Beauty seedless as 0.59 per cent and 1.41 per cent as tartaric acid in variety Bhokri.

Srinivasan and Shammugavelu (1971) observed the titratable acidity of certain off season mango varieties ranging from 0.385 (Alphanso) to 1.768 (Khudabad) per cent.

Gosh *et al.* (1985) reported the range of acid content in ripe fruits of mango varieties as 0.06 to 0.32 per cent.

Khurdiya and Roy (1985) studied the effect of different methods of extraction on the quality of jamun juice and recorded the range of its acidity from 0.40 per cent to 1.49 per cent.

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

Shinde (1993) reported that the average titratable acidity in A, B, C and D grades of sapota Cv. Kalipatti was 0.12, 0.11, 0.10 and 0.12 per cent, respectively.

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.

Mannan *et al.* (2003) recorded minimum (0.022 %) and maximum (0.032%) titratable acidity in cv. Sharmai Fazri and Amrapali fruits, respectively at ripe stage.

2.2.3. Sugars (reducing and total sugars)

Pruthi and Lal (1955) studied the physico-chemical composition of some important fruit juices in which large scale variation in the reducing and total sugar contents was noticed. They reported the sugar content in fruit juices as passion fruit juice- 4.13 to 9.27 per cent reducing sugars and 10.47 to 10.71 per cent total sugars; pineapple juice- 4.02 to 11.42 per cent; apple juice- 8.10 and 9.82 per cent; grape juice- 14.09 and 16.66 per cent; kagzi lime juice- 0.20 and 0.30 per cent; tomato juice-2.27 and 2.71 per cent, reducing and total sugars, respectively.

Khurdiya and Anand (1981) reported that the phalsa juice contained 18.12 per cent reducing sugars and 17.98 per cent total sugars.

Vilaschandran and Damodaran (1984) while studying storage of cashew apple juice reported that the fresh cashew apple juice contained 12.50 per cent reducing sugars.

Antarkar (1986) reported that the cashew apple juice of variety vengurla 1 had 10.15 per cent reducing sugars and 11.52 per cent total sugars while the variety vengurla 2 had 9.76 and 11.21 per cent reducing sugars and total sugars, respectively.

Marathe (1989) found that the reducing and total sugar content in cashew apple juice of varieties vengurla 1 to vengurla 4

varied in the range of 9.87 to 9.43 and 11.72 to 10.50, respectively in studies on unfermented beverages from cashew apple.

Joshi *et al.* (1990) reported 3.26, 3.67 and 3.98 per cent reducing sugars at ripe stage at ambient temperature (24.5 to 32.9 ^{0}C; 97 % RH) and 2.91, 3.55 and 3.78 per cent in cool chamber stored fruits at (26 – 27 ^{0}C; 97 % RH) in fruits having specific gravity of less than 1, 1 to 1.02 and greater than 1.02, respectively in Alphonso mango fruits.

Anila and Radha (2003) reported maximum reducing sugars (2.97 %) in Ratna followed by H-151 (2.66%), Alphonso (2.43 %), Neelum (2.35 %), Prior (2.29 %) and in Muvandan (2.23 %) varieties of mango fruits, at ripe stage.

Chatterjee *et al.* (2005) reported maximum reducing sugars (6.77 %) in cv. Sundar Langra followed by Langra (6.74 %), while it was minimum (4.15 %) in Mahmud bahar at ripe stage.

Peter *et al.* (2007) observed 3.59 per cent reducing sugars on 6th day of storage in cv. Dodo mango fruits at ripe stage in smoke pit treatment.

2.3 Physical parameters of blended crush

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*, h values of different juices of berries in 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 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.

Chaovanalikit *et al.* (2012) reported 20.42 ± 0.18 L* value for colour in mangosteen juice prepared from concentrate under vaccume evaporator + pectinase.

2.4 Changes in chemical composition of blended crush 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 decreasing trend in 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.

Ravi et al. (2010) prepared orange-white pumpkin crush with using 75:25 (v/v) per cent fruit juice and preparing sugar syrup with

66 per cent strength and adding potassium meta bisulphate @ 600 ppm.

Shikhare (2014) prepared sapota syrup blended with kokum juice and they 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 crush

Marimuthu and Thirumaran (2000) reported the decrease in organoleptic score of jamun syrup during the 6 months of storage.

Kotecha and Kadam (2003) prepared the R.T.S. beverage, syrup and concentrate from tamarind. All these products have been satisfactorily preserved and stored for over 180 days without affecting their quality.

Gajanana *et al.* (2007) standardized the recipe of aonla syrup. The results revealed that the syrup consisting of 55% aonla juice + 10% lime juice + 4% ginger + sugar adjusted to a T.S.S. of 68^0Brix was found to have the highest organoleptic scores with respect to colour and appearance, taste, flavour and overall acceptability.

Das (2009) studied the storage stability of jamun beverages where the jamun products were found to be acceptable up to five months of storage.

Reddy and Chikkasubbanna (2009) studied the storage behaviour of amla syrup. Syrup prepared with 25 per cent pulp and 70^0 Brix total soluble solids was found to be the best recipe with

respect to the organoleptic qualities like appearance, aroma and flavour, taste, and overall acceptability up to 90 days 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 standard plate count determined in Malta orange squash was found to be quite safe after a storage periods 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 – III

MATERIAL AND METHODS

The present research work entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.) mango (*Mangifera indica* L.) crush" 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 2014-2015. The blended crush was prepared by using pineapple and mango pulp. The material used and methods adopted fruits during the course of investigation are presented in this chapter.

3.1 Experimental material

The pineapple fruits required for conducting research were procured from APMC, Vashi. The frozen alphanso mango pulp available with the Dept. Of PHM of FVF was used for the present investigation.

The experiment entitled studies on preparation of blended pineapple:mango crush was laid out with seven 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 Mango (*Mangifera indica* L.)
2.	Design	:	F.C.R.D.
3.	Number of treatment combinations	:	7×4=28
4.	Replications	:	3

I) Details of treatment

The treatments comprised of different proportions of pineapple and mango pulp in the blended crush as given below.

A. Main treatments Proportion of pineapple and mango pulp

T1:	90:10
T2:	80:20
T3:	70:30
T4:	60:40
T5:	50:50
T6:	40:60
T7:	100:0

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 monopon electronic balance. The recovery percentage of pulp was calculated by the following formula,

$$\text{Pulp recovery (\%)} = \frac{\text{Weight of pulp (g)}}{\text{Weight of fresh fruit (g)}} \times 100$$

3.2.2 Chemical composition of the pineapple (*Ananas comosus* L.) and frozen mango (*Mangifera indica* L.) pulp.

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

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

Total soluble solids were determined using Hand refractrometer (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.

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

3.2.2.3 Reducing sugars

The reducing and total sugars were estimated by using Lane and Eynon method (1923) 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.

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

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.

$$\textbf{Total sugars}\ (\%) = \frac{\text{Factor X Dilution}}{\text{Titre reading X Weight of sample}} \text{X100}$$

3.2.3 Preparation and evaluation of pineapple *(Ananas comosus* L.*)* mango (*Mangifera indica* L.) blended crush.

3.2.3.1 Selection and preparation of fruits

The fully ripe, fresh and sound pineapple fruits were selected for the preparation of blended crush. 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 Alphanso mango pulp frozen at -18° C temperature was used for blending with pineapple juice after bringing it to a normal temperature.

3.2.3.2 Preparation of blended crush

For the preparation of blended crush the pineapple juice and mango pulp 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 55° Brix TSS and 1.0 per cent acidity of the blended crush. The mixture was then heated to dissolve the sugar completely.

3.2.3.3 Filling and storage of the blended crush

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 crush.

The crush 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 crush

3.2.5.1 Colour

The colour of syrup was determined as L*, a*, b* values using a colorimeter which denote lightness, red colour and yellow colour, respectively.

3.2.6 Changes in chemical composition of the crush during storage

The changes in chemical constituents such as T.S.S., titratable acidity, reducing sugars and total sugars content of the blended crush 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 crush 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 petriplates under the Laminar Air Flow. The sample of each treatment was taken on a separate petriplate, 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 parafilm and incubated at 37^0 C for 48 hrs. to check bacterial count and kept it for 5-6 days at room temperature for fungal count. Total microbial plate count was measured in colony forming unit/gram.

3.2.8 Changes in organoleptic qualities of the blended crush

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 crush with organoleptic score of 5.5 and above was rated as acceptable. The crush was evaluated organoleptically by diluting it with chilled water in the proportion of 1:3.

3.2.9 Statistical Analysis

The data collected on physical parameters of pineapple and mango fruits such as juice recovery, colour (L* a* b*), microbial count of prepared product 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-mango blended crush

Selection of ripe pineapple fruits

⇩

Washing and peeling of pineapple fruits

⇩

Extraction of juice

⇩

Blending of pineapple and frozen Alphanso mango pulp in different proportions as per treatment

⇩

Addition of sugar, citric acid, water and mixing it with the blended pulp as per the recipe

⇩

Hot filling the product in presterilized glass bottles

⇩

Pasturization at 85^0 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.) mango (*Mangifera indica* L.) crush" 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 2014 – 2015. 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 juice recovery of pineapple fruit

The data pertaining to the juice recovery of pineapple are presented in Table 1 and it could be observed from the data that the average juice recovery of pineapple was 50.30 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 Chemical composition of fruit juice

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

4.1.2.1 Total soluble solids (° Brix)

4.1.2.1 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 14.00 ^{0} Brix.

Pruthi and Lal (1955) reported that the T.S.S of ripe pineapple fruit was 13.32 ^{0}Brix.

4.1.2.1 b) Mango

The data regarding the total soluble solids content of mango fruit juice presented in Table 2 indicate that the total soluble solids (T.S.S.) content of mango pulp was 20.2 ^{0}Brix. Identical observation was also reported by Patil (1990).

4.1.2.2 Titratable acidity (%)

4.1.2.2 a) Pineapple

The results presented in Table 1 indicate that the average titratable acidity of pineapple juice was 0.4 per cent. Khurdiya (1987) reported the acidity of pineapple juice in the range of 0.3 to 0.8 per cent.

4.1.2.2 b) Mango

The results presented in Table 2 indicate that the average titratable acidity of mango pulp was 0.204 per cent. The finding was similar to the observations reported by Patil (1990). Nanjudaswamy *et al.* (1966) found that the acidity of mango fruit ranged from 0.12 to 0.71 per cent.

4.1.2.3 Sugars % (reducing and total sugars)

4.1.2.3 a) Pineapple

The data with respect to reducing and total sugars of pineapple juice are presented in Table 1. The per cent reducing and total sugar content of pineapple juice was 4.00 to 10.52 per cent, respectively. The similar observations were also recorded by Pruthi and Purthi and Lal (1955) who studied the physico-chemical composition of some important fruit juices in which large scale variation in the reducing and total sugar contents was noticed in pineapple juice and it was 4.02 to 11.42 per cent, respectively.

4.1.2.3 b) Mango

The data with respect to reducing and total sugars of mango pulp are presented in Table 2. The per cent reducing and total sugar content of mango pulp was 4.80 and 15.31 per cent, respectively. The observation in accordance with this finding was also reported by Patil (1990).

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

4.2.1 Physical parameters of blended crush

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 crush revealed that the L* value for colour influenced significantly due to recipe treatments as well as the storage period. The treatment T7 recorded highest (34.52) mean L* value for colour, followed by the treatment T1 (32.39) and T3 (30.74). The lowest (28.76) mean L* value for colour was observed in the treatment T6 which was at par with the treatments T6 (28.76) and T5 (29.58) Thus, it is observed from the data that the L* value declined with rise in the level of mango pulp in the blended crush as the mango pulp increased the cloudiness of blended crush.

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 (33.95) colour L* value was recorded at 0 days of storage and the lowest (28.87) mean colour L* value was observed at 90 days of storage.

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

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 mango-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 crush. 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 T6 recorded highest (4.44) mean a* value for colour, followed by the treatments T5 (3.59) and T4 (3.08). The lowest (2.09) treatment mean found in T7 which was at par with the treatment T1 (2.13). The treatment T2 (2.52) was at par with treatments T3 (2.52) and T1 (2.13). The a* value for the colour indicates the redness of the product. The increased proportion of mango pulp in the product darkened the colour of the blended crush.

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 (4.41) mean a* value for colour was recorded at 90 days of storage and the lowest (1.52) 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 treatments T7 and T1 recorded minimum (0.30 and 0.70, respectively) a* value for colour

at 0 day of storage wherever at was minimum (6.67) in the treatment T6 after 90 days of storage ambient condition.

The similar observations to this are also reported by Khurdiya (1993) who observed that the Amrapali nectar possessed 6.79 times higher values of a* and then those of Totapuri, respectively.

4.2.1.1.3 b* value for colour

The data with respect to the colour b* value of blended crush 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 T6 recorded highest mean (44.60) b* value, followed by the treatments T5 (43.19), and T4 (41.66). The lowest (34.39) b* value for colour was observed in the treatment T7, followed by the treatment T1 (36.28). The treatment T2 (37.58) was at par with the treatments T1 (36.28) and T3 (37.94).

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 (43.17) mean b* value for colour was recorded at 90 days of storage and the lowest (35.15) 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 (48.60 and 48.27, respectively) b* value for colour was observed in the treatments T6 and T5 at 90 days of storage where as it was lowest (31.10, 31.97 and 32.87, respectively) in the treatments T7, T2 and T3.

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.

4.2.2 Chemical parameters of blended crush

4.2.2.1 Total soluble solid (^{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 crush. It could be observed from the data that the T.S.S. of the blended crush varied significantly due to the treatments under study. Among the treatments, the highest (55.63°B) mean was noticed in the treatment T6 which was at par with the treatment T5 (55.57°B). The treatment T4 (55.52°B) was at par with treatments T5 (55.57°B) and T3 (55.45°B). The treatment T7 exhibited significantly minimum (55.27^{0}B) mean T.S.S. among all treatments. However, it was at with T1 (55.39°B). Thus, it is clear from the data that the TSS of the blended crush increased with rise in the relative proportion of mango pulp in the product. This could be due to the fact that more polysaccharides would be available for the conversion into simpler sugars with higher level of mango pulp in the blended crush.

It is evident from the results that initially, the crush exhibited a minimum (55.01^{0}B) mean T.S.S. and it was significantly increased to maximum (55.88^0 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 crush during storage might be due to hydrolysis of polysaccharides like starch, cellulose and pectin substance into simpler substances. Similar results were recorded by Marimuthu and Thirumaran (2000) who recorded an increase in the T.S.S. from 70 to 72^0 B in jamun syrup during 0 to 3 months of storage and similar observations were

observed by Jadhav *et al.* (2004) in ripe karonda syrup during storage period of 240 days. Lad *et al.* (2013) also recorded identical observation in lime cv. saisharbati squash and Kalunkhe *et al.*(2014) in lemon seedless cv. konkan seedless.

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 crush 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:mango crush was highest in the treatment T1 (0.985%), however, it was at par with rest of the treatments except the treatment T2 which recorded significantly lowest (0.960%) mean titratable acidity. The lower acidity in the treatment T2 than rest of the treatments could possibly be due to low acidity of the product initially at 0 day in the treatment T2.

It was also noticed from the Table 7 that the mean titratable acidity was significantly decreased from initial 1.071 per cent to 0.919 per cent up to 90 days of storage period. The decrease in titratable acidity of the product might be due to utilization of acids for conversion of non-reducing sugars into reducing sugars during storage. Similar observations were reported Nath *et al.* (2005) in ginger kinnow squash. As per the studies carried out by Koargaokar *et al.* (2015) and Kalunkhe *et al.*(2014) the acidity was decreased during three month's storage in snap melon syrup and lemon squash cv. konkan seedless, respectively.

4.2.2.3 Reducing sugars

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

(22.77%) in the treatment T6, followed by the treatments T5 (21.77%) and T4 (20.77%). The lowest (15.41%) mean reducing sugar content was noticed in the treatment T7, followed by the treatment T1 (17.73%) and T2 (18.25%). It is observed from the data that the reducing sugar content increased with the increase in the level of mango pulp in the blended crush.

The variation in reducing sugars during storage was found significant after three months of storage period. The reducing sugar content of the blended crush was increased from 12.46 to 27.15 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-mango squash, Reddy and Chikkasubbanna (2009) in amla syrup, Kalunkhe *et al.* (2014) in lemon squash cv. konkan seedless and Korgaokar *et al.* (2014) in snap melon syrup.

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 crush 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 T6 recorded the highest (44.46%) mean total sugars whereas the treatment T7 recorded significantly lowest (39.84%) mean total sugar content of the blended crush. The

treatments T3 (42.35%) and T4 (42.66%) were at par with each other. Thus, it is clear from the data that the mango pulp 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 mango pulp in the product.

The total sugar content increased significantly from 38.93 per cent at the time of preparation to 45.51 per cent after 90 days of storage. The interaction between treatment and storage period was found significant. The total sugar content was the highest (47.47%) in the treatment T6 after 90 days of storage whereas, it was the lowest (35.05%) in the treatment T7 at 0 day of storage.

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-mango 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 count of blended crush

The result related to the microbial count for bacteria as well as for fungi in blended crush was presented in the Table 10 and Fig. 8. It is clear from the data that the microbial count in blended crush

was influenced by the recipe treatments and the results were statistically significant. The highest (1.00cfu/ml) mean microbial count was observed in the treatment T7 whereas it was nil in the treatments T3 to T6.

A significant increase in mean microbial count of blended crush from 0 to 0.24 cfu/ml was observed in 90 days of storage period. However, the microbial count of blended crush was negligible irrespective of the treatments during storage period of 90 days. The interaction between treatments and storage period with respect to microbial count was found statistically non-significant.

The analogous results to these findings were reported by Reddy and Chikkasubhana (2009) in amla syrup, Lad *et al.* (2013) in lime squash, Kalunkhe *et al.* (2014) in konkan lemon squash and Deka (2000) in lime-aonla and mango-pineapple spiced – RTS beverages.

4.4 Changes in organoleptic qualities of pineapple:mango blended crush during storage

It could be revealed from the data that the pineapple:mango blended crush 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 crush influenced by different treatments and storage period are presented in Table 11 and graphically illustrated in Fig. 9.

It could be noticed from the data that the changes in the organoleptic score for colour of the crush, prepared by seven different treatments were statistically significant. The treatment T6 recorded highest (7.83) mean score for colour, but it was at par with

the treatment T5. The lowest mean (6.71) score for colour was recorded by the treatment T7. However, it was at par with the treatments T1 (7.04) and T2 (7.08). The treatments T1 to T4 were at par with each other.

Thus, it is clear from the data that the blended crush had better colour than the straight pineapple crush. Among all the blends, the sensory score for the colour was not influenced even through the level of mango pulp in the crush raised to 40 per cent, however, the colour was improved by raising the mango pulp level to 50 or 60 per cent in the crush.

The variation in the organoleptic score for colour during storage was found statistically significant. The significantly higher (7.52) 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 non-significant.

Analogous observation to these finding were reported by Marimuthu and Thirumaran (2000) and Das (2009) in jamun beverages where colour of the jamun products was found to be acceptable up to five months of storage.

4.4.2 Flavour

The changes in the organoleptic score for flavour of blended syrup are presented in Table 12 and illustrated in the Fig 10.

It is observed from the data that the blended crush was significantly superior to the straight pineapple crush with respect to the flavour irrespective of the proportion of pineapple juice and mango pulp in the crush and the treatments T1 to T6 were at par

with each other. The treatment T7 i.e straight pineapple crush recorded the lowest (6.71) sensory score for flavour of the product.

The organoleptic score for flavour of the blended crush reduced significantly during storage, which was maximum (7.76). immediately after preparation, but decreased to a score of 7.19 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 Texture

The data on the changes in the organoleptic score for texture of blended crush influenced by different treatments and storage period are presented in Table 13 and graphically illustrated in Fig. 11.

It could be noticed from the data that the changes in the organoleptic score for texture of the crush, prepared by seven different treatments were statistically significant. The treatment T5 recorded highest (7.83) mean score for texture, but, at par with the treatment (7.38). The lowest (6.29) mean score for texture was recorded by the treatment T7, however it was at par with the treatments T4 (6.54), T3 (6.50), T2 (6.42) and T1 (6.42).

From the initial observations, it was observed that the separation of colloidal particles and the sugar syrup in the crush was reduced with increased proportion of mango pulp in the blended crush and a uniform dispersion of colloidal particles was noticed in the crush where the mango pulp was added in the

proportion of 50:50 (T5) or 40:60 (T6) pineapple:mango and there by the improving the texture of the product.

Thus, for preparation of pineapple crush, the mango pulp in 50:50 proportion could be used as a stabilizer for the uniform dispersion of colloidal particles in the crush

The variation in the organoleptic score for texture during storage was found statistically significant. The significantly higher (7.10) mean organoleptic score for texture was recorded immediately after preparation which was decreased with the advancement of the storage period. The interaction effect between storage and treatment was found to be statistically non-significant. Similar observations were also reported by Phuangsinoun *et al.* (2008) who obtained reported that the clouding of carrot juice increased with increase in the pectin concentration.

4.4.4 Overall acceptability

It is evident from the data presented in Table 14 and Fig. 12 that the changes in the organoleptic score for overall acceptability of blended crush due to treatments were found statistically significant.

It is noticed from the data that the treatment T5 was significantly superior to the rest of treatments with respect to overall acceptability, except the treatment T7 i.e. straight pineapple crush. The treatment T5 scored maximum mean (7.68), but at par with treatment T6 (7.55). The lowest (6.71) mean organoleptic score for overall acceptability of the product was recorded by the treatment T7, followed by the treatments T1 to T4. The crush from all the pineapple:mango blends was significantly superior to the straight pineapple crush with respect to overall acceptability of the product. Thus, it is clear from the data the good quality blended crush with

respect to overall acceptability could be prepared by using pineapple and mango pulp in the proportion of 50:50 or 40:60.

In storage, the organoleptic score for overall acceptability of the crush declined significantly i.e. from 7.46 to the score of 6.89 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) and Das (2009) 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 crush is given in Table 15. From the results, it could be observed that the total expenditure for production of blended crush was highest (Rs. 12851.15/-) in the treatment T6 i.e. 40:60 (pineapple:mango) and lowest (Rs. 10802.1/-) in T7 i.e straight pineapple crush

Higher gross returns and net profit of Rs. 15421.38/-and Rs. 2570.23/-, respectively was found in T6 i.e. 40:60 (pineapple:mango) and lowest gross returns (Rs. 12962.52/-) and net profit (Rs. 2160.42/-) in T7 i.e straight pineapple crush. The sale price was maximum (Rs30.84/-) in T6 40:60 (pineapple:mango) and lowest (Rs. 25.92/-) in the treatment T7 (straight pineapple crush). 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 (50 pineapple: 50 mango) and T6 (40:60) were the best recipes for the blended crush among all the recipes with

low cost of production and comparatively higher gross returns on the investment. Sale price for the treatments T-5 and T6 for 200 ml crush bottle was Rs. 29.97/- and Rs. 30.84/-, respectively. Thus, it was lower in the treatment T5 than the treatment T6.

CHAPTER V

SUMMARY AND CONCLUSION

The research project entitled "Studies on preparation of blended pineapple (*Ananas comosus* L.) mango (*Mangifera indica* L.) crush" 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 2014 – 2015.

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

5.1 Per cent juice recovery of pineapple -

The average juice recovery of pineapple was 50.3 per cent.

5.2 Chemical composition of fruit juices.

The T.S.S and titratable acidity of pineapple fruit juice was 14.00° brix and 0.40 per cent, respectively. The reducing and total sugars of pineapple fruit juice were 4.00 and 10.52 per cent, respectively

The mango pulp had 20.00°brix T.S.S with 0.204 per cent titratable acidity. The reducing sugars and total sugars in the mango pulp were 4.80 and 15.31 per cent, respectively.

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

5.3.1 Physical parameters of blended crush

5.3.1.1 L* Value for colour

The treatment T7 i.e. straight pineapple crush recorded the highest (34.52) mean L* value for colour. The lowest (28.76) mean L*

value for colour was observed in the treatment T6 i.e 40:60 ratio of pineapple:mango pulp in the crush.

The decreasing trend was seen up to 90 days of storage. The highest (33.95) mean colour L* value was recorded at 0 day of storage and the lowest (28.27) at 90 days of storage.

5.3.1.2 a* value for colour

The treatment T6 i.e. (40 pineapple juice: 60 mango pulp) recorded the highest (4.44) mean a* value for colour. The lowest (2.09) mean a* value for colour was observed in the treatment T7 (straight pineapple crush).

The increasing trend was seen up to 90 days of storage. The highest (4.41) mean a* value for colour was recorded at 90 days of storage and the lowest (1.52) was observed initially at the time of preparation of the crush.

5.3.1.3 b* value for colour

The treatment T6 i.e. 40:60 (pineapple:mango) recorded the highest (44.60) mean b* value for colour. The lowest (34.39) mean b* value for colour was observed in the treatment T7 i.e Straight pineapple crush. The increasing trend was seen up to 90 days of storage. The highest mean (43.17) b* value for colour was recorded at 90 days of storage and the lowest (35.15) mean b* value for colour was observed at 0 days of storage.

5.3.2 Chemical composition of blended crush

The changes in the chemical constituents of blended crush 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-6 i.e. 40:60 (pineapple:mango) recorded maximum (55.63° B) mean T.S.S. while it was minimum (55.27^0 B) in the

treatment T-7 (Straight pineapple crush). A significant increase in the T.S.S. of crush was noticed throughout the storage period of 90 days.

2. While considering the acidity of blended crush, it was decreased significantly with the advancement of the storage period. The highest (0.985%) mean titratable acidity was recorded in the treatment T1 i.e 70:30 (pineapple:mango) and the lowest acidity i.e. 0.960% per cent was recorded in the treatment T-2 i.e 80:20 (pineapple:mango).
3. As far as reducing sugar content in blended crush is concerned, the treatment T6 i.e 40:60 (pineapple:mango) recorded significantly highest (22.77%) reducing sugars and lowers (15.41%) in the treatment T7 i.e straight pineapple crush. There was an increase in the reducing sugar content of crush irrespective of treatments during storage.
4. Total sugar content of blended crush exhibited variation due to the treatments and increased significantly during the storage. The maximum (44.46%) total sugar content was recorded in treatment T-6 i.e 40:60 (pineapple:mango). The minimum (40.06%) total sugar content was noticed in the treatment T7 i.e Straight pineapple crush.

Thus, an increasing trend in T.S.S, reducing sugars and total sugars was observed while a decreasing trend in the acidity of blended crush was noticed during storage period of 90 days.

5.4 Microbial analysis of blended crush

At 0 day of the storage, the microbial count was nil in all the treatments. The increase in mean microbial count from 0 to 0.24cfu/ml irrespective of the treatments was observed after 90 days of storage of blended crush.

5.5 Changes in organoleptic qualities of blended crush

The blended crush prepared from pineapple fruit juice and mango pulp was organoleptically acceptable after 90 days of storage.

Among different recipes, the treatment T5 i.e 50:50 (pineapple:mango) recorded maximum (7.63, 7.58, 7.83 and 7.68, respectively) mean score for colour, flavour, texture and overall acceptability of the blended crush. The organoleptic score of blended crush was decreased irrespective of the treatments throughout the storage period of 90 days. Among all the recipes, the crush recipes i.e 50:50 (pineapple:mango) and 40:60 (pineapple:mango) were found to be superior in organoleptic qualities to all other recipes .

5.6 Economics of the blended crush

As far as the economics of blended crush is concerned, among all the treatments, the treatment T-7 i.e. straight pineapple crush recorded the lowest sale price i.e. Rs. 25.92/- and highest in the treatment T-6 (Rs.30.84/-).

From organoleptic point of view, the treatments T5 and T6 were the best treatments. Among these best treatment, the treatment T5 i.e 50:50 (pineapple:mango) recorded the lower sale price than the treatment T6.

CONCLUSION

From the present investigation, it could be concluded that, all the recipes of blended crush 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.

The blended crush prepared from pineapple fruit juice and frozen mango pulp was significantly superior with respect to overall acceptability of the product to the straight pineapple crush.

The crush recipe i.e. 50:50 (pineapple:mango) was found to be the best recipe for blended crush with highest organoleptic score for colour, flavour and overall acceptability and higher gross returns on the investment. For the preparation of pineapple crush, mango pulp could used as a stabilizer in 50:50 proportion for uniform dispersion of colloidal particles in the product.

Table 15: Cost of Production of blended crush (100 kg)

Sr. No.	Particulars	T1	T2	T3	T4	T5	T6	T7
1.	**Cost of pineapple fruits @ Rs.40/- per kg**	3220.67	2862.80	2504.97	2147.11	1789.26	1431.41	3578.52
2.	**Cost of frozen mango pulp @ Rs.150 /- per kg**	675	1350	2025	2700	3375	4050	-
3.	**Labour charge @ Rs. 200/- per skilled and Rs. 120/- per unskilled Labour**	440	440	440	440	440	440	440
4.	**Glass bottle @ Rs. 5/- per bottle**	2500	2500	2500	2500	2500	2500	2500
5.	**Sugar @ Rs. 30/- per kg**	1377	1371	1362	1353	1347	1338	1386
6.	**Citric acid @ Rs. 25.5/- per 100gm**	204	204	204	204	204	229	204
7.	**KMS @ Rs.634/- per kg**	25.67	22.82	19.97	17.11	14.26	11.41	28.53
8.	**Plastic caps @ Rs. 50/- per 100 caps**	250	250	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	69.41	69.41

	Cost of Production							

1 .	**Working capital**	8761.75	9070.03	9375.35	9680.63	9988.93	10319.23	8456.46
2.	**Supervision charges @ 10% of the working capital**	876.17	907.00	937.53	968.06	998.89	1031.92	845.64
3.	**Depreciation charges @ 2% of the fixed capital @ 2 % on ` 10000**	200	200	200	200	200	200	200
4.	**Interest on fixed capital@ 13 % on Rs. 10000/-**	1300	1300	1300	1300	1300	1300	1300
5.	**Total cost of production (A)**	11137.92	11477.03	11812.88	12148.69	12487.82	12851.15	10802.1
6.	**Gross returns (B)**	13365.5	13772.43	14175.45	14578.42	14985.38	15421.38	12962.52
7.	**Net profit (B-A) Rs.**	2227.58	2295.40	2362.57	2429.73	2497.56	2570.23	2160.42
8.	**Benefit : cost (B/A)**	1.2	1.2	1.2	1.2	1.2	1.2	1.2
9.	**Sale price per 200 ml bottle**	26.73	27.54	28.35	29.15	29.97	30.84	25.92

Table 1. Juice recovery and chemical composition of Pineapple juice

Sr. No	Particulars	Mean*
A.	Juice recovery (%)	50.30
B.	Chemical parameters	
1.	T.S.S. (^{0}B)	14.00
2.	Titratable acidity (%)	0.40
3.	Reducing sugars (%)	4.00
4.	Total sugars (%)	10.52

* The values are the means of three observations.

Table 2. Chemical composition of frozen mango pulp

Sr. No	Particulars	Mean*
A.	Chemical parameters	
1.	T.S.S. (^{0}B)	20.20
2.	Titratable acidity (%)	0.204
3.	Reducing sugars (%)	4.80
4.	Total sugars (%)	15.31

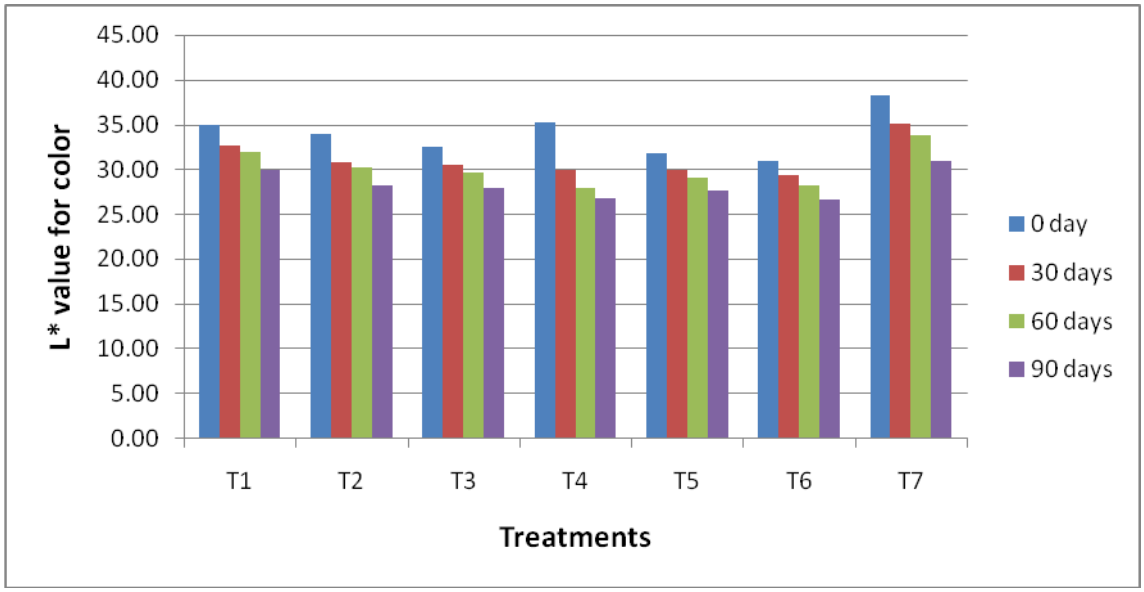
***** The values are the means of three observations.

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

	L* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	35.00	32.70	31.90	29.97	32.39
T2	33.90	30.77	30.13	28.17	30.74
T3	32.53	30.43	29.60	27.90	30.12
T4	35.23	29.93	27.90	26.77	29.96
T5	31.83	29.87	29.07	27.53	29.58
T6	30.97	29.27	28.17	26.63	28.76
T7	38.20	35.10	33.83	30.93	34.52
Mean	33.95	31.15	30.09	28.87	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.45	1.28
Storage (S)	0.34	0.97
Interaction (TXS)	0.90	NS

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

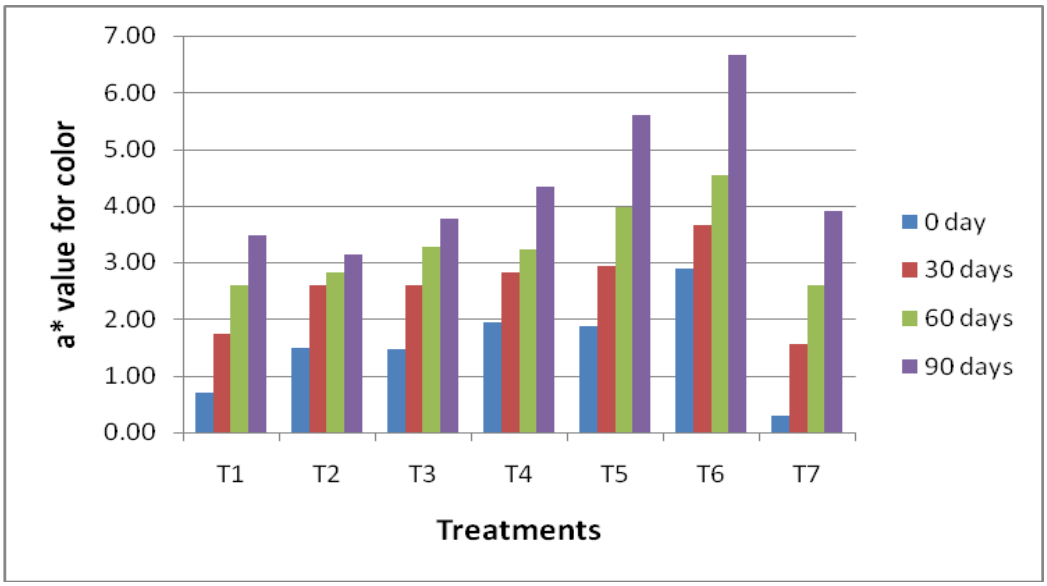
T7- 100:0 (Pineapple:Mango)

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

	a* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	0.70	1.73	2.60	3.47	2.13
T2	1.50	2.60	2.83	3.13	2.52
T3	1.47	2.60	3.27	3.77	2.78
T4	1.93	2.83	3.23	4.33	3.08
T5	1.87	2.93	3.97	5.60	3.59
T6	2.90	3.67	4.53	6.67	4.44
T7	0.30	1.57	2.60	3.90	2.09
Mean	1.52	2.56	3.29	4.41	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.14	0.41
Storage (S)	0.11	0.31
Interaction (TXS)	0.29	0.83

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

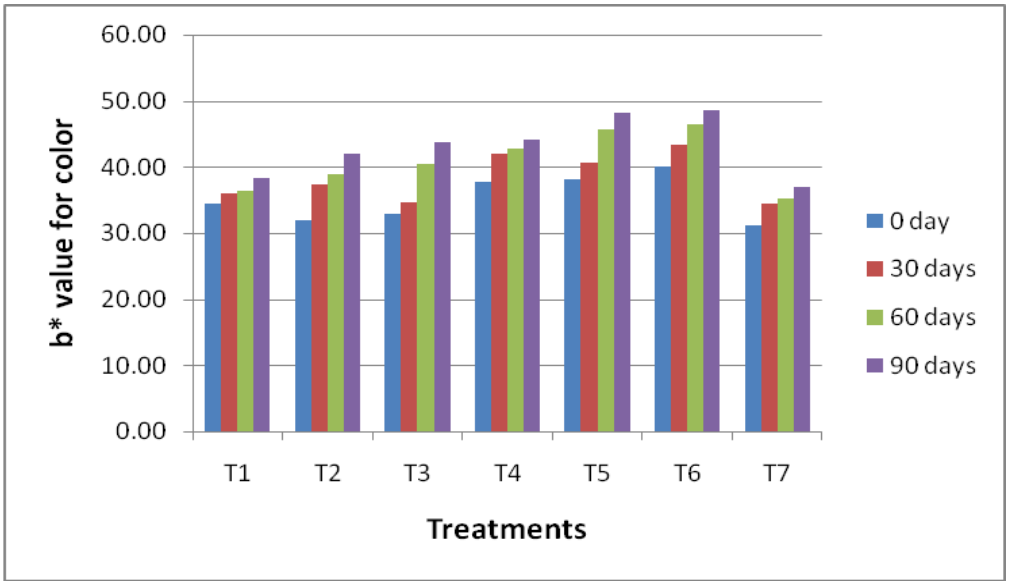
T7- 100:0 (Pineapple:Mango)

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

	b* value for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	34.37	35.97	36.40	38.37	36.28
T2	31.97	37.37	38.97	42.03	37.58
T3	32.87	34.67	40.40	43.83	37.94
T4	37.70	41.97	42.83	44.13	41.66
T5	38.07	40.67	45.77	48.27	43.19
T6	40.00	43.30	46.50	48.60	44.60
T7	31.10	34.37	35.13	36.97	34.39
Mean	35.15	38.33	40.86	43.17	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.48	1.36
Storage (S)	0.36	1.03
Interaction (TXS)	0.96	2.72

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

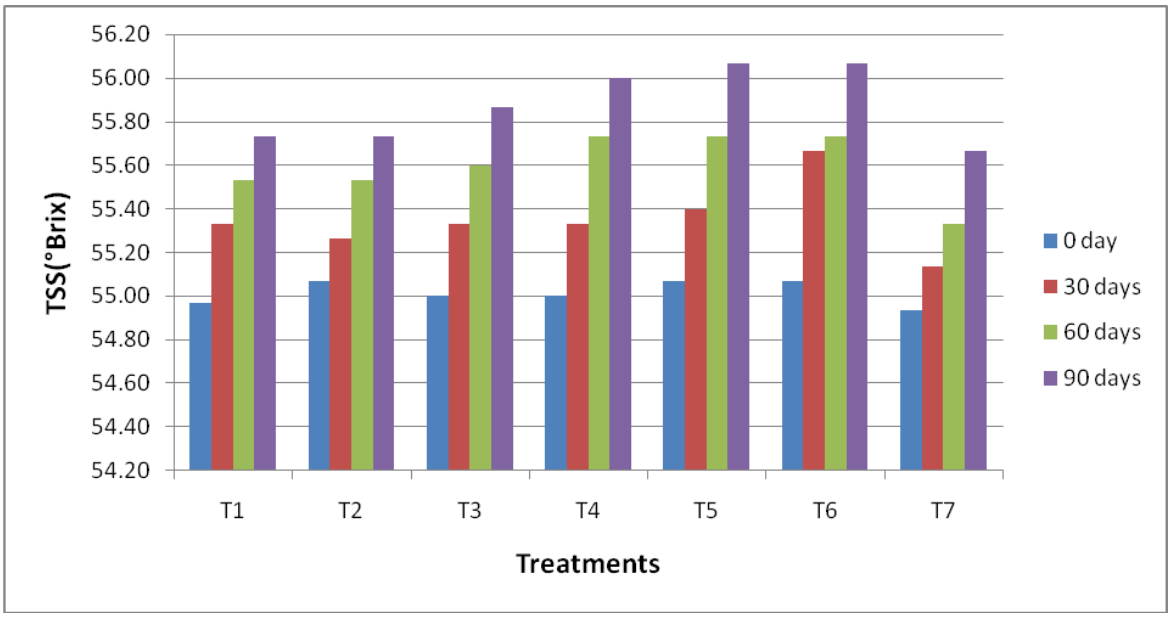
T7- 100:0 (Pineapple:Mango)

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

	TSS (^{0}B)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	54.97	55.33	55.53	55.73	55.39
T2	55.07	55.27	55.53	55.73	55.40
T3	55.00	55.33	55.60	55.87	55.45
T4	55.00	55.33	55.73	56.00	55.52
T5	55.07	55.40	55.73	56.07	55.57
T6	55.07	55.67	55.73	56.07	55.63
T7	54.93	55.13	55.33	55.67	55.27
Mean	55.01	55.35	55.60	55.88	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.03	0.10
Storage (S)	0.02	0.08
Interaction (TXS)	0.07	N.S

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

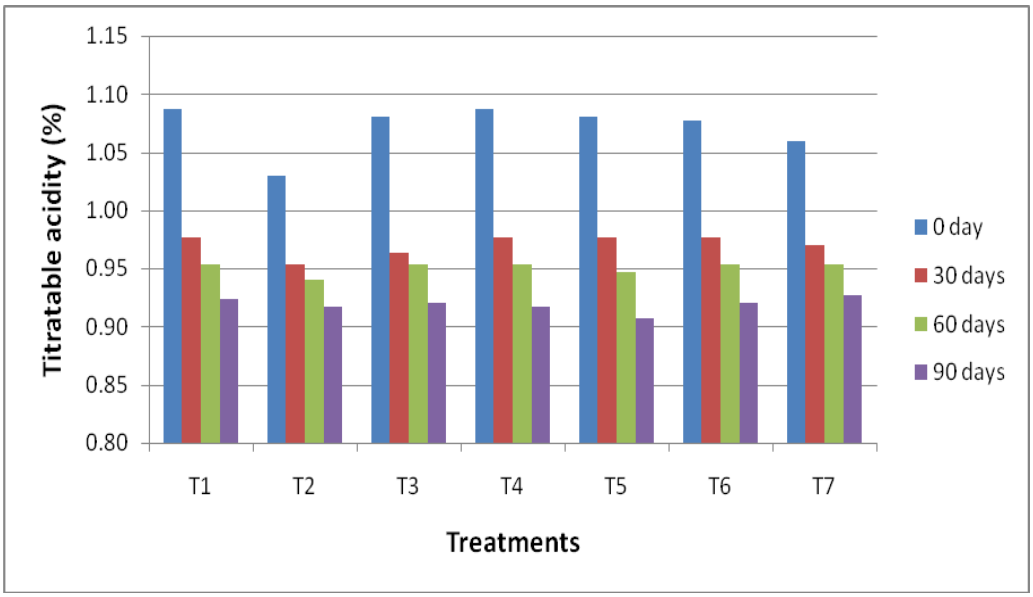
T7- 100:0 (Pineapple:Mango)

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

	Titratable acidity (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	1.09	0.98	0.95	0.92	0.985
T2	1.03	0.95	0.94	0.92	0.960
T3	1.08	0.98	0.95	0.92	0.979
T4	1.09	0.98	0.95	0.92	0.983
T5	1.08	0.98	0.95	0.91	0.978
T6	1.08	0.98	0.95	0.92	0.982
T7	1.06	0.97	0.95	0.93	0.978
Mean	1.071	0.970	0.950	0.919	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.003	0.010
Storage (S)	0.003	0.008
Interaction (TXS)	0.007	NS

Fig. 5. Changes in Titratable acidity of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

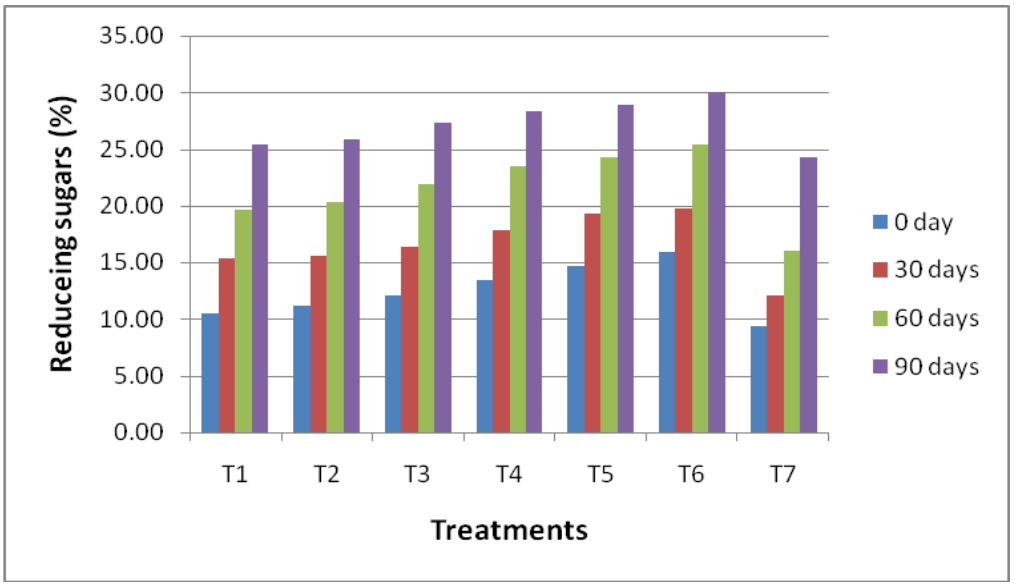
T7- 100:0 (Pineapple:Mango)

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

	Reducing sugars (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	10.49	15.31	19.67	25.44	17.73
T2	11.19	15.63	20.28	25.88	18.25
T3	12.10	16.33	21.94	27.29	19.42
T4	13.43	17.86	23.48	28.32	20.77
T5	14.73	19.25	24.24	28.87	21.77
T6	15.87	19.74	25.44	30.02	22.77
T7	9.39	12.04	15.98	24.24	15.41
Mean	12.46	16.59	21.57	27.15	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.27	0.76
Storage (S)	0.20	0.57
Interaction (TXS)	0.54	NS

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

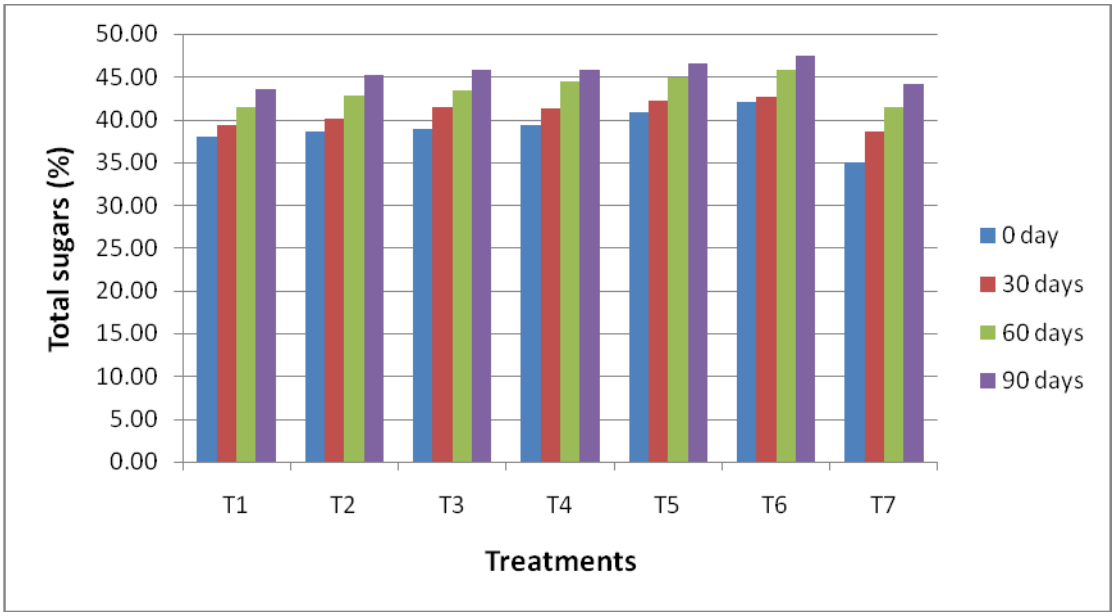
T7- 100:0 (Pineapple:Mango)

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

	Total sugars (%)				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	37.92	39.27	41.45	43.61	40.56
T2	38.66	40.11	42.86	45.18	41.70
T3	38.86	41.44	43.36	45.75	42.35
T4	39.27	41.22	44.40	45.75	42.66
T5	40.77	42.14	44.91	46.59	43.60
T6	42.00	42.62	45.73	47.47	44.46
T7	35.05	38.66	41.44	44.21	39.84
Mean	38.93	40.78	43.45	45.51	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.19	0.54
Storage (S)	0.14	0.41
Interaction (TXS)	0.38	1.09

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



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

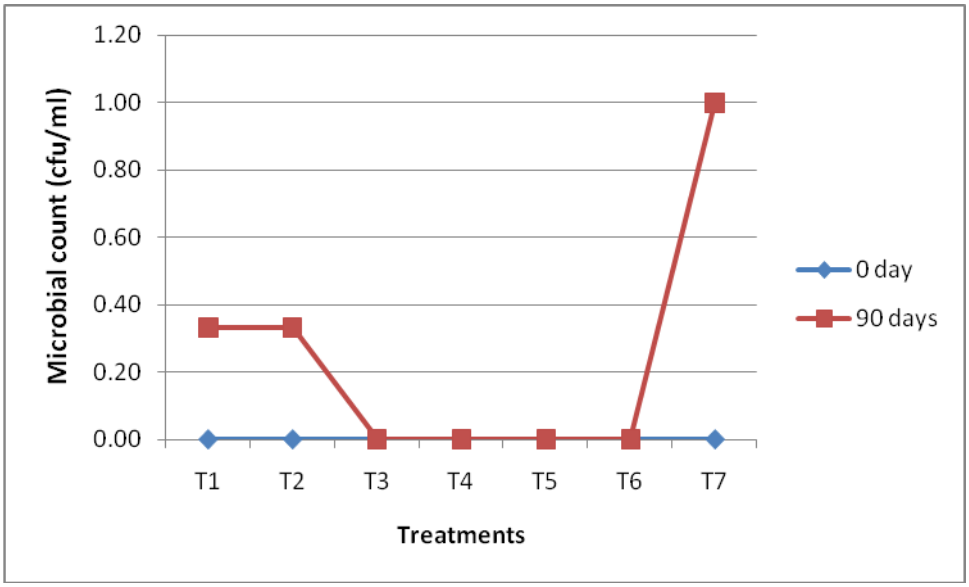
T7- 100:0 (Pineapple:Mango)

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

	Microbial count (cfu/ml)		
Treatments	**Storage period (Days)**		
	0	**90**	**Mean**
T1	0.00	0.33	0.17
T2	0.00	0.33	0.17
T3	0.00	0.00	0.00
T4	0.00	0.00	0.00
T5	0.00	0.00	0.00
T6	0.00	0.00	0.00
T7	0.00	1.00	1.00
Mean	0.00	0.24	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.08	0.25
Storage (S)	0.04	0.13
Interaction (TXS)	0.12	NS

Fig. 8. Changes in microbial count of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

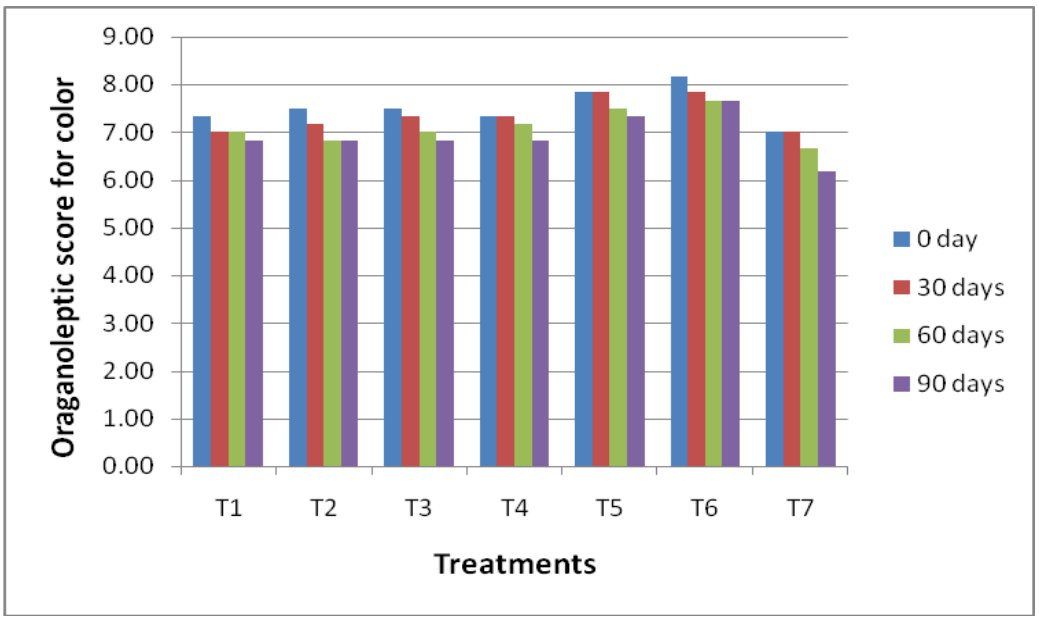
T7- 100:0 (Pineapple:Mango)

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

	Organoleptic score for colour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	7.33	7.00	7.00	6.83	7.04
T2	7.50	7.17	6.83	6.83	7.08
T3	7.50	7.33	7.00	6.83	7.17
T4	7.33	7.33	7.17	6.83	7.17
T5	7.83	7.83	7.50	7.33	7.63
T6	8.17	7.83	7.67	7.67	7.83
T7	7.00	7.00	6.67	6.17	6.71
Mean	7.52	7.36	7.12	6.93	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.15	0.42
Storage (S)	0.11	0.32
Interaction (TXS)	0.30	NS

Fig. 9. Changes in the organoleptic score for colour of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

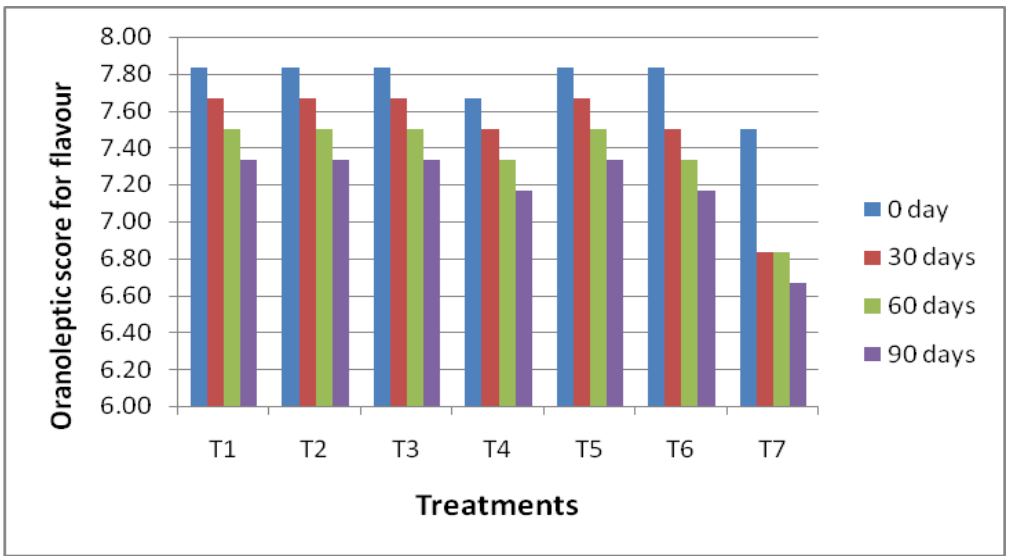
T7- 100:0 (Pineapple:Mango)

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

	Organoleptic score for flavour				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	7.83	7.67	7.50	7.33	7.58
T2	7.83	7.67	7.50	7.33	7.58
T3	7.83	7.67	7.50	7.33	7.58
T4	7.67	7.50	7.33	7.17	7.42
T5	7.83	7.67	7.50	7.33	7.58
T6	7.83	7.67	7.33	7.17	7.46
T7	7.50	6.83	6.83	6.67	6.96
Mean	7.76	7.50	7.36	7.19	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.12	0.36
Storage (S)	0.09	0.27
Interaction (TXS)	0.25	NS

Fig. 10. Changes in the organoleptic score for flavour of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

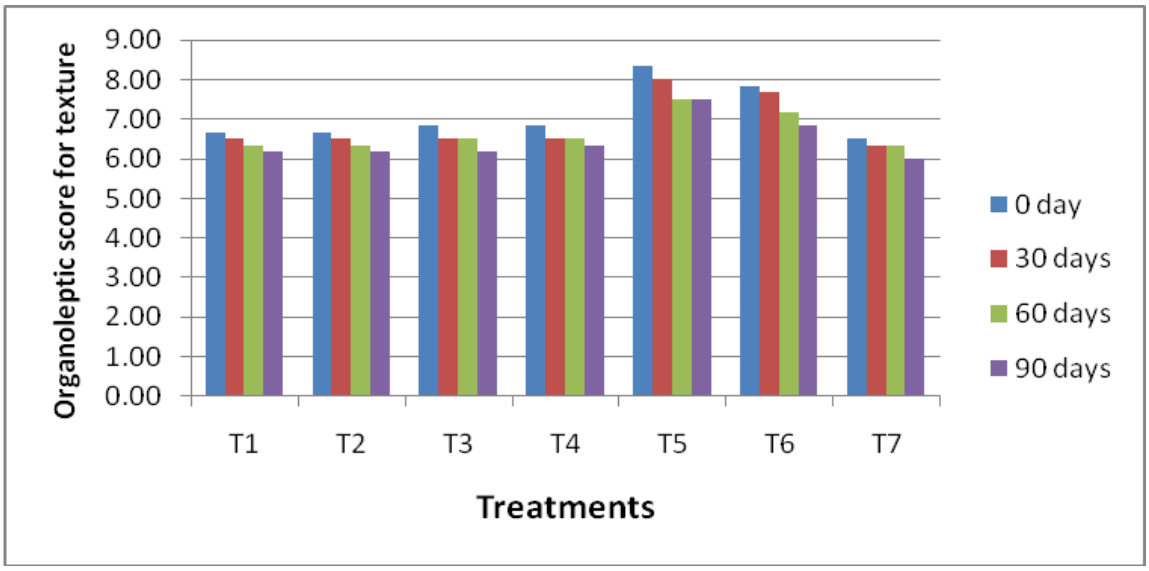
T7- 100:0 (Pineapple:Mango)

Table 13. Changes in the organoleptic score for texture of pineapple:mango blended crush during storage at ambient condition

	Organoleptic score for texture				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	6.67	6.50	6.33	6.17	6.42
T2	6.67	6.50	6.33	6.17	6.42
T3	6.83	6.50	6.50	6.17	6.50
T4	6.83	6.50	6.50	6.33	6.54
T5	8.33	8.00	7.50	7.50	7.83
T6	7.83	7.67	7.17	6.83	7.38
T7	6.50	6.33	6.33	6.00	6.29
Mean	7.10	6.86	6.67	6.45	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.16	0.46
Storage (S)	0.12	0.34
Interaction (TXS)	0.32	NS

Fig. 11. Changes in the organoleptic score for texture of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

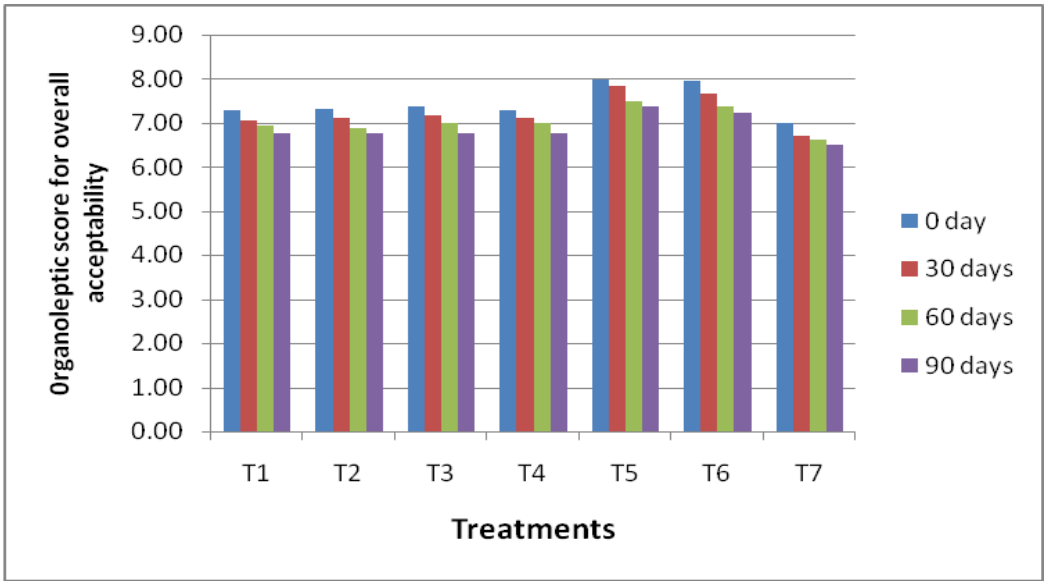
T7- 100:0 (Pineapple:Mango)

Table 14. Changes in the organoleptic score for overall acceptability of pineapple:mango blended crush during storage at ambient condition

	Organoleptic score for overall acceptability				
Treatments	**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**
T1	7.28	7.05	6.94	6.77	7.01
T2	7.33	7.11	6.89	6.77	7.02
T3	7.39	7.16	7.00	6.78	7.08
T4	7.27	7.11	7.00	6.77	7.04
T5	8.00	7.83	7.50	7.39	7.68
T6	7.94	7.66	7.39	7.22	7.55
T7	7.00	6.72	6.61	6.50	6.71
Mean	7.46	7.24	7.04	6.89	

	S.E.m ±	C.D. at 5 %
Treatment (T)	0.10	0.28
Storage (S)	0.07	0.21
Interaction (TXS)	0.20	NS

Fig. 12. Changes in the organoleptic score for overall acceptability of pineapple:mango blended crush during storage at ambient condition



T1- 90:10 (Pineapple:Mango)

T2- 80:20 (Pineapple:Mango)

T3- 70:30 (Pineapple:Mango)

T4- 60:40 (Pineapple:Mango)

T5- 50:50 (Pineapple:Mango)

T6- 40:60 (Pineapple:Mango)

T7- 100:0 (Pineapple:Mango)

LITERATURE CITED

*A.O.A.C. (1975). Official Methods of Analysis. Association of Official Analytical Chambers. 12th Edition, Washington, D.C. 2004.

*Amerine, M. A., Pangborn R. M. and Rocssler E. B. (1975). Principle of Sensory Evaluation of Food. Academic Press, London.

Anila, R. and Radha, T. (2003). Physico-chemical analysis of mango varieties under Kerala conditions. *Journal of Tropical Agriculture*, 41: 20-22.

Anonymous (2010a). National Horticulture Board, Department of Agriculture and Corporation, Government of India, annual report, pp 86-95.

Anonymous, (2003). Competitiveness in pineapple canning Industry. http//:www.hicbusiness.org/A

Anonymous, (2007). Agricultural and processed food products export development authority. Area and production of pineapple. http://www.apeda.com

Anonymous, (2013). Area, Production and productivity of mango in India and in Maharashtra, state wise. *Indian Horticulture database,* pp. 93-94.

Anonynous (2010b). USDA National Nutrients Database for standard Reference, Release, 23.

Antarkar, M. V. (1986). Studies on maturity indices of cashew apple and nut (*Anacardium occidentale* L.) and Post Harvest Technology of cashew apple. A M.Sc. (Agri.) thesis submitted to the Konkan Krishi Vidyapeeth, Dapoli, Dist: Ratnagiri (M.S.).

Asgekar, M. A. (2002). Studies on physico-chemical composition some aspects of post-harvest handling and processing of pineapple (*Ananas comosus* (L.) Merr.) cv. Kew fruits. A M.Sc. (Agri.) thesis submitted to Kokan Krushi vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra State.

*Attri, B. L., B. B. Lal and V. K. Joshi (1998). Physico-chemical characteristics, sensory quality and storage behaviour of sand pear juice blended with temperate fruit juices/pulps. *Ind. Fd. Packer*, **52** (6): 36.

Baker, Kenneth F. and J. L. Collins (1939). Notes on the distribution and ecology of Ananas and Pseudananas in South America. *Amer. Jour.* Bot. 26: No. 9, 697-702.

Bhandari, S. P. (2004). Studies on physico-chemical composition, grading, storage and processing of jamun [*Syzygium cuminii* (Linn.) skeels]. A M. Sc. (Agri.) thesis submitted to Kokan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra.

*Bhatia, B. S., Sidappa G. S. and Giridhari Lal (1956). Physico-chemical changes in jackfruit squash during storage. *Indian J. Agril. Sci.,* **26**(4): 403-414.

*Bhatnagar, P. and Chandra A. (2002). Physico – chemical characteristics of Kagzi lime fruits. *Agril. Science Digest,* **22**(2): 117-119.

Chaovanalikit, A., Mingmuang, A., Kitbunluewit, T., Choldumrongkool, N., Sondee, J. and Chupratum, S. (2012). Anthocyanin and total phenolics content of mangosteen and effect of processing on the quality of mangosteen products. *Int. Food Research J.,* **19**(3): 1047-1053.

Chatterjee, D., K. R. Maurya and M. P. Mandal (2005). Physico-chemical characteristics of mango (*Mangifera indica* .Linn) hybrids in Bihar. *Orissa Journal of Horticulture*, **33** (2): 57-61.

Chattopadhyay, S. B. (1976). Mango land Indian life. *Indian Fd. Packer*, 30 (5): 110-114.

*Chopra and Singh (2009). Studies on standerdization and shelf stability of Malta (*Citrus sinensis*) orange beverages. *Indian Fd. Packer,* pp. 46-53.

Dalvi, R. B. (1998). Studies on carbonation of fruit based beverages. A M.Sc. (Agri.) thesis submitted to Konkan Krushi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra.

Das, J. N. (2009). Studies on storage stability of jamun beverages. *Indian J. Hort.*, **66**(4): 508-510.

*Deka, Bidyut C. (2000). Preparation and storage of mixed fruit juice spiced beverages. Ph. D. Thesis, IARI, New Delhi.

Dhutade P. R. (2012). Studies on standardization of sapota juice powder. A M.Sc. (Post harvest management) thesis submitted to the Post Graduate Institute of Post Harvest Management, Killa-Roha, Dist Raigad, Maharashtra state.

*Ejechi, B. O., Souzey, J. A. and Akpomedaya D. E. (1998). Microbial stability of mango juice preserved by combined application of mild heat and extracts of two tropical spices. *J. Food Protection,* **61**(6) : 725.

Farid Hossain, Shaheen Akhtar, Mustafa Anwar (2015). Nutritional Value and Medicinal Benefits of Pineapple. *International Journal of Nutrition and Food Sciences*; 4(1): 84-88.

Gajanana, K., A. K. Rokhade and P. B. Patil (2007). Standardization of recipe for preparation of aonla syrup. *Beverage and Food World,* **34** (3): 47-48.

Gole, R. S. (1986). Studies on fruit development and some aspects of post harvest handling of mango (*Mangifera indica* L.) fruits. A M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri.

Gosavi, P. G. (1998). Studies on drying and utilization of dried kokum (*Garcinia indica* Choisy) and karonda (*Carissa carandas* L.) fruits. A M.Sc. (Agri.) thesis submitted to Kokan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra.

*Gosh, S. K., R. S. Dhua and S. K. Mitra (1985). Studies on Physico-chemical characteristics of some mango cultivars grown at West Bengal. *Ind. Fd. Packer*, **39** (1): 46-50.

Hossain, M. M., M. A. Haque., M. A. Rahim and M. H. Rahman (2001). Physico morphological and compositional variation in ripe fruit of three mango varieties. *J. of Biological Sci.,* **1** (11): 1101-1102.

Jadhav, S. B. (1996). Studies on grading, storage and processing of kokum (*Garcinia indica* Choisy) and karonda (*Carissa carandas* Linn.). M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, and Dist. Ratnagiri (M.S.).

Jadhav, S. B., G. D. Joshi and V. K. Garande (2004). Studies on the preparation and storage of karonda (*Carissa carandas* Linn.) fruit products. *Beverage and Food World*, **31**(5): 46-47.

*Joshi, G. D., M. G. Salvi and C. D. Pawar (1990). Seminar on strategies for increasing mango production held by KKV, Dapoli and Hexamar Agril. Research and Development

Foundation, Mumbai on March 22-23, 1990. pp. 255 - 269.

Kalunkhe, S., P.P. Relekar and K.H. Pujari (2014). Studies on recipe and storage behavior of lemon (Citrus Limon Burm) squash CV. KOKAN SEEDLESS. Ecology, *Environment and conservation paper,* 20(1):149-152.

Kannan, S. and A. S. Thirumaran (2004). Studies on storage life of jamun (*Syzygium cuminni* Rom) fruit products. *J. Food Sci. Technol.*, **41**(2) : 186-188.

Khurdiya, D. S. (1993). Composition and Quality of nectar prepared from blended pulps of Amrapali and Totapuri mangoes. *J. Food Sci. Technol.*, 30 (2): 139-140.

*Khurdiya, D. S. and J. C. Anand (1981). Effect of storage temperatures on the quality of phalsa beverage. *J. of Ad. Sci. and Technol.,* **18**(4): 160-161.

*Khurdiya, D. S. and S. K. Roy (1985). Processing of jamun (*Syzygium Cuminii* Linn.) fruit into a ready to serve beverage. *J. Fd. Sci. Technol.,* **22**(1): 27-30.

Khurdiya, D.S. (1987). Processing and Preservation of pineapple products.*Beverage and Food World*, 14(1): 51-52.

*Kiiyukia C. (2003). Laboratory manual of food microbiology for ethopian health and nutrition research institute. December 2003. pp. 17-18.

Korgaonkar, Pujari, K.H. and Morgaonkar (2015). Effect of different acidity levels of snap melon syrup on chemical and sensory properties. *IOSR Journal of Agriculture and Veterinary Science*, **8**(4): 01-03.

Kotecha, P. M. and S. S. Kadam (2003). Preparation of ready-to serve beverage, syrup and concentrate from tamarind. *J. Food Sci. Technol.,* **40**(1): 76-79.

*Krishna, M. M., D. S. Khurdiya and M. Raychaudhari (1969). Utilization of Bhokri grape. *Indian Fd. Packer,* **23**(4): 10-11.

Kulkarni, M. M. (2000). Studies on some aspects of post harvest handling and processing of mango (*Mangifera indica* L.) fruits cv. Ratna. A M.Sc. (Agri.) thesis submitted to Kokan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra.

Lad, P. K., P.P. Relekar and K.H. Pujari (2013). Quality evaluation and storage behaviour of lime (Citrus aurantafolia) squash CV. SAI SHARBATI. *The Asian journal of Horticulture*, **8**(1): 350-353.

*Lane, J.H. and Eyon, L. (1923). Determination of reducing sugars by Fehling's solution with methylene blue as internal indicator. *J. Soc. Chem. Ind.,* 42:32.

Lee Siew Yoong (2006). Physical, chemical and quality properties of agglomerates and their beverages from fluidized bed drying of calamansi, pineapple and starfruit juice. *The Institutes of Engineers*, **67**(4): 26-33.

*Mannan, A., K. U. Khan., M. R. Islam., M. Sirajul and Ayesha Siddique (2003). A study on the physio-chemical characteristics of some mango varieties in Khulana region.*Pak. J. Bio. Sci.,* **6** (24): 2034-2039.

Marathe, A. V. (1989). Studies on unfermented beverages from cashew (*Anacardium occidentale* L.) apple. A M.Sc. (Agri.) thesis submitted to the Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.).

Marimuthu, M and Thirumaran, A. S. (2000). Utilization of jamun-juice, squash and syrup. *Beverage and Food world,* **27**(8): 42&46.

NajundaSwamy, A. Rahim and G. S. Siddappa (1966). Proximate composition and suitability for preservation of some important varieties of mangoes grown in Salem. *Indian food Packer*, **20** (3): 15-21.

Narayana, C. K., R. K. Pal and S. K. Roy, (1996). Effect of pre-storage treatments and temperature regimes on shelf-life and respiratory behaviour of ripe Baneshan mango. J. Food Sci. Tech., 33: 79-82.

Nath, A., Yadav D.S.,PramabjyotiS.andDey B. (2005). Standardization of ginger-kinnow squash and its storage.*J.Food Sci.Technol.***42** (6): 520-522.

*Nawale, R. N. (1987). Cashewapple – An important by product of cashewnut industry. *Beverage and Food world,* **14**(3): 28-29.

Pal, R. and Sethi, V. (1992). Chemical changes during storage of kagzi lime syrup at different temperatures. *Maharashtra J. Hort.,* **7**(2): 83-88.

Panse, V. G. And P. V. Sukhantme (1985). Statistical method of Agricultural. Indian council of Agricultureal research, New Delhi.

Patil, S. A. (1990). Evaluation of mango (Mangifera indica L) cv. Alphonso, Ratna, Pairi and Kesar fruits for physico-chemical composition, storage and processing. M.Sc. (Agri.) thesis submitted to the Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (MS).

*Peter, M., L. Fwejw, B. Chove, J. Kinabo, V. George and M. Kawaswijii (2007). Physical and chemical characteristics of off vine ripened mango (Mangifera indica L.) fruit (Dodo). *African J. of Biotech.,* **6** (21): 2477 – 2483.

Phuangsinoun, P., Sudarat Harnkham and Prasong Siriwongwilaichat (2008). Cloud stabilizing properties of pectin from pomelo peel in carrot juice. *As. J. Food Ag-Ind.,* **1** (01): 37-42.

Pruthi, J. S. and Girdhari, Lal. (1955) Studies on the technological aspects of the manufacture of passion fruit juice and squash. *Chemical Age of India*, 6. pp. 39-48.

Ranganna, S. (1997). Handbook of analysis and quality control for fruits and vegetable products. 2nd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.

Rashmi, H.B., Doreyappa, G. and Mukanda, G.K. (2005). Studies on osmo-air dehydration of pineapple fruits.J. Food Sci.Technol., 42: 64-67.

Ravi, U., Lakshmi Menon, M. Aruna and B. K. Jananni (2010). Development of Orange-White Pumpkin Crush and Analysis of its Physicochemical, Nutritional and Sensory Properties American Eurasian *J. Agric. & Environ. Sci.*, 8(1): 44-49.

Reddy, A. H. and V. Chikkasubbanna (2009). Studies on the storage behaviour of amla syrup. *The Asian Journal of Horticulture*, **3**(2): 203-207.

Rein, M. J. and M. Heinonen (2004). Stability and enhancement of berry juice colour. Department of Applied Chemistry and Microbiology, Division of Food Chemistry, University of Helsinki, Finland.

Saad, S. (2004). The world pineapple market; when growth goes hand in hand with diversity. http//:www.tanusi.com/

*Satyavati, V. K., A. V. Bhat, A. George and K. K. Mookerji (1972). Studies on the suitability of different varieties of mangoes of Kerala for processing. *Indian Fd. Packer*, **26** (4): 8-12.

Saxena, A.K., M.S. Teotia and S.K. Berry (1996). Studies on development of grape-mango and grape-pineapple beverages blends. *Indian Fd Packer,* **50**(4): 26-30.

Shikhare N. S. (2014). Standardization of sapota (*Manilkara achras (mill) Foseberg*) syrup blended with Kokum (*Garcinia indica var choisy*) juice. A M.Sc. (Post Harvest Management) thesis submitted to the Post Graduate Institute Of Post Harvest Management, Killa-Roha, Dist Raigad, Maharashtra State.

Shinde, U. S. (1993). Studies on some aspects of post harvest handling and processing of sapota (*Manilkara achras*) (Mill.) Forsberg. cv. Kallipatti fruits. A M.Sc. (Agri.) thesis submitted to the Konkan Krishi Vidyapeeth, Dapoli, Dist: Ratnagiri (M.S.).

*Sondhi, S. P. (1962). Variation in physico-chemical characters of cashewapple juice based on analysis in 1962 season. Associate thesis Cent. Fd. Techno. Res. Inst. Mysore.

*Sonkar, R. K. and M. S. Ladaniya (1995). Effect of fruit maturity and degreening on bitterness of nagpur mandarin juice. *Indian Fd. Packer,* **49**(6): 11-16.

*Spayd, S. E., C. W. Nagel., L. D. Hayrynem and S. R. Drake (1984). Colour stability of apple and pear juices blended with fruit juices containing anthocyanins. *J. Food Sci.*, **49**: 411.

*Srinivasan, C. and K. G. Shammugavelu (1971). Proximate composition of certain off-season mango varieties of Tamilnadu. *South Indian Horticulture*, **19** (1-4): 24-28.

*Vilaschandran, T. and V. K. Damodaran (1984). Physico-chemical qualities of cashew apples of high yielding types. Proceedings of the International Cashew Symposium, Cochin, Kerala, India.

Yadav S., Gehlot S., Siddiqui R.B., Grewal (2014). Changes in chemical constituents and overall acceptability of Guava-Mango RTS and squash.*Beverage and food world,* vol.41 No. 4.

---

*Original not seen