# "STUDIES ON PREPARATION OF *KALAKAND* WITH ADDITION OF KINNOW JUICE"

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**B.Sc. (Agriculture)**

**MASTER OF SCIENCE**

**IN**

**AGRICULTURE**

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**COLLEGE OF AGRICULTURE, PARBHANI**

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**PARBHANI- 431 402 (M. S.) INDIA**

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# "STUDIES ON PREPARATION OF *KALAKAND* WITH ADDITION OF KINNOW JUICE"

**BY**

**MASKE GOVIND VYANKATI**

**B.Sc. (Agriculture)**

A thesis submitted to

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

in partial fulfilment of the requirement for the degree of

**MASTER OF SCIENCE**

**IN**

**AGRICULTURE**

**(ANIMAL HUSBANDRY AND DAIRY SCIENCE)**

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**PARBHANI- 431 402 (M. S.) INDIA**

**2022**

# DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled, **"Studies on Preparation of *Kalakand* with Addition of Kinnow Juice"** submitted by me is based on the actual work carried out by me under the guidance and supervision of **Gajendra Kondiba Londhe**. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or it's any part is not been submitted anywhere else for the award of any degree or diploma.

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Place : Parbhani

Date : 25 / 02 / 2022

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**Reg. No: 2019A/83M**

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| W | URL: https://www.researchgate.net/publication/270876213_PREPARATION_OF_KALAKAND_WITH_SAPOTA_FRUIT<br>Fetched: 2021-04-02T13:43:49.2970000 | 2 |
| W | URL: https://www.ijcmas.com/8-6-2019/Suryakant%20N.%20Hekre,%20et%20al.pdf<br>Fetched: 2021-12-10T10:02:07.6500000 | 3 |
| W | URL: https://www.thepharmajournal.com/archives/2018/vol7issue6/PartA/7-7-135-806.pdf<br>Fetched: 2021-12-10T10:02:06.6130000 | 11 |
| SA | **VNM Krishi Vidyapeeth / Mayur Thesis for plagrisum.pdf**<br>Document Mayur Thesis for plagrisum.pdf (D111203725)<br>Submitted by: prabhakarpadghan@yahoo.co.in<br>Receiver: prabhakarpadghan.vnmkv@analysis.urkund.com | 3 |
| W | URL: https://www.semanticscholar.org/paper/Blending-of-safflower-milk-with-buffalo-milk-for-of-Dhanwade-Santakke/bd42f98e3145f97fea10129c56ba9ec2655d5d8b<br>Fetched: 2021-12-10T10:02:20.5500000 | 1 |
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| SA | **Ph.D. Thesis Arsul SR 18PHDT202.pdf**<br>Document Ph.D. Thesis Arsul SR 18PHDT202.pdf (D126772668) | 3 |
| W | URL: https://agris.fao.org/agris-search/search.do?recordID=US202100189301<br>Fetched: 2022-02-23T08:07:50.0800000 | 2 |
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*Place: Parbhani* ***(Govind V. Maske)***

*Date:* 25 / 02 */2022* ***Reg. No: 2019A/83M***

# CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF PLATES

# ABBREVIATIONS

| | | |
|---|---|---|
| / | : | Per |
| @ | : | At the rate of |
| $^0$C | : | Degree Celsius |
| BIS | : | Bureau of Indian Standard |
| Cal | : | Calorie |
| *et al.* | : | And co-workers |
| Fig. | : | Figure |
| G | : | Gram (s) |
| Kcal | : | Kilo Calorie |
| Kg | : | Kilogram (s) |
| L | : | Litre |
| Max | : | Maximum |
| Min | : | Minimum |
| Ml | : | Milliliter |
| Mm | : | Millimeter |
| No. | : | Number |
| pH | : | Negative logarithm of hydrogen ion concentration |
| RPM | : | Revolution per minute |
| SSHE | : | Scraped Surface Heat Exchanger |
| viz. | : | Namely |
| FSSAI | : | Food Safety and Standard Authority of India |
| WHO | : | World Health Organization |
| IS | : | Indian Standards |
| PFA | : | Prevention of Food adulteration (Act) |
| ISI | : | Indian Standards Institution |
| TPA | : | Texture Profile Analysis |
| TPC | : | Total Plate Count |
| YMC | : | Yeast and Mold count |
| C.D. | : | Critical Difference |
| S.E. | : | Standard Error of Mean |
| psi | : | Pound Per Square Inch |
| SNF | : | Solid Not Fat |
| MT | : | Millions Tones |
| RO | : | Reverse Osmosis |
| c.f.u. | : | Colony forming unit |
| Log | : | Logarithm |
| ± | : | Plus or minus |
| ≤ | : | Less than |

# THESIS ABSTRACT

# THESIS ABSTRACT

| | | | |
|---|---|---|---|
| 1 | Title of thesis | : | Studies on Preparation of *Kalakand* with Addition of Kinnow Juice |
| 2 | Full name of the candidate | : | Govind Vyankati Maske |
| 3 | Name of Research Guide | : | Dr. G. K. Londhe |
| 4 | Department | : | Animal Husbandry and Dairy Science |
| 5 | College/University | : | College of Agriculture, VNMKV, Parbhani. |
| 6 | Degree to be awarded | : | Master of Science (Agriculture) |


## ABSTRACT

The research study was carried out on "Studies on Preparation of *Kalakand* with Addition of Kinnow Juice". Research work was conducted in the laboratory of department of Animal Husbandry and Dairy Science, College of Agriculture, VNMKV, Parbhani during the year 2020-21.

*Kalakand* was prepared from buffalo milk (standardized with 6 per cent fat and 9 per cent SNF) with constant level of sugar (6 per cent by volume of milk) and different level of kinnow juice (10, 15, 20 and 25 part by vol. of milk). It was observed that the overall acceptability score for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 8.31, 8.37, 8.54, 8.19 and 7.83 respectively. As the level of kinnow juice in *kalakand* increases the overall acceptability score also increases upto treatment $T_3$, thereafter it was decreased. The treatment ($T_3$) comprises kinnow juice @ 15 per cent secured maximum score with 8.54 and lowest score was found to be 7.83 in treatment $T_5$.

On an average kinnow juice *kalakand* of treatments $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ contained moisture 17.05, 17.40, 19.30, 20.75 and 22.63 per cent, fat 21.33, 20.90, 20.14, 18.89 and 17.48 per cent, protein 15.30, 14.94, 14.22, 13.51 and 12.84 per cent, ash 3.1, 2.85, 2.8, 2.55 and 2.43 per cent, total solids 82.95, 82.60, 80.70, 79.25 and 77.38 per cent, total carbohydrate 41.67, 42.70, 43.30, 43.80 and 44.15 per cent, titratable acidity 0.33, 0.38, 0.52, 0.59 and 0.75 per cent total acidity, pH 6.74, 6.59, 6.40, 6.21 and 6.05 respectively. Storage study was conducted at refrigerated (7±2ºC) temperature conditions. The SPC values of *kalakand* samples at $0^{th}$ day were 15.10 to 17.50 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. The SPC values of *kalakand* samples at $6^{th}$ day were 6.8 to 9.1 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. The SPC values of *kalakand*

samples at $12^{th}$ day were 2.4 to 8.0 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. The SPC in *kalakand* sample decreased as storage period progressed up to 12 days. The YMC values of *kalakand* samples at $0^{th}$ day were 1.45 to 0.45 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. The YMC values of *kalakand* samples at $6^{th}$ day were 1.8 to 0.5 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. The YMC values of *kalakand* samples at $12^{th}$ day were 1.75 to 0.65 x $10^3$ cfu/g for treatment $T_1$ to $T_5$. Coliform count was found nil at refrigerated (7±2ºC) temperature conditions. On storage period of 0 and 12th days YMC counts increased from treatment $T_1$ to $T_5$.

The production cost of *kalakand* with addition of kinnow juice was Rs. 330.72, Rs. 381.2, Rs. 419.14, Rs. 449.79 and Rs. 482.39 per kg for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively. The highest cost obtained for the treatment $T_5$ (Rs.482.39). It was noticed that cost of product increased from Rs. 330.72 to 482.39 with increased in the addition of kinnow juice.

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(**Keywords:** Indigenous, Dairy product, *Kalakand*, Kinnow juice, Natural flavour.)

# CHAPTER-I

# INTRODUCTION

## CHAPTER - I

# INTRODUCTION

India rank 1st in world milk production. Several measures have been initiated by the government to increase the productivity of livestock, which has resulted in increasing the milk production significantly. Milk production in country has increased from 146.3 million tones in 2014-2015 to 198.4 million tones in 2019-20. In 2019-20 milk production increased by 5.68 per cent as compared to the previous year. The per capita availability of milk was 407 grams per day in 2019-20 (Economic Survey, 2020-21).

Milk is a food of outstanding interest, not least because it was designed to be a complete food for young growing animals. A balanced diet is essential for proper health and growth. The milk and milk products is providing the nutrients required for a balanced diet. It supply body-building proteins, bone forming minerals and health-giving vitamins and furnishes energy-giving lactose and milk fat. All these properties make milk an important food for growing children, adolescents, adults, invalids, convalescents and patients. Out of total milk produced in the country buffalo milk account 50 per cent followed by cow milk 46 per cent and goat milk is about 4 per cent. Among 100 per cent of total milk production, 46 per cent milk is consumed as a liquid form while remaining 54 per cent used for the preparation of milk products, in which 7 per cent is used for the preparation heat and acid coagulated indigenous milk products. Among which *kalakand* is one of the products. The demand of milk and milk product is increasing day by day. In India, The demand of traditional milk products is increasing rapidly due to the increasing population and it has widespread popularity and acceptability of product (Su kumar, 1982).

Among the indigenous milk products *kalakand* occupies a prominent place in India especially in the eastern part of India. Now a days, this product is popular in northern and central part of India. *Kalakand* is the indigenous milk product obtained by heat desiccation /concentration of whole standardized milk with subsequent addition of proper coagulant and sugar.

The following recipe for preparation of *kalakand* such as take required quantity of milk and boil it in a container with continuous stirring through *khunti* in a

rotational motion. After 20-25 min of stirring required quantity of diluted citric acid should be added into the milk for coagulation. Make semisolid consistency through continuous stirring during heating and add sugar @ 6 per cent, crushed cardamom if desired and stir well for 5 min. Final product is set in a greasy tray for reduce the chances of stickiness and allow to cool at room temperature (De, 1991).

*kalakand* is partially desiccated milk based sweet prepared from acidified milk with caramelized flavour and granular texture. It contains 70.40 per cent total solid, 14.20 per cent carbohydrate, 21 per cent fat, 2.40 per cent ash, 0.50 per cent lactic acid (Suresh and Jha 1994).

*Kalanand* also accompanies reduction of water activity results in destruction of pathogenic micro-organism and inactivation of enzyme activity. The main reaction in preparation is denaturation and coagulation of milk proteins. The color of *kalakand* varies from off white to light caramel color. Being a whole milk concentrate, *kalakand* is a good source of proteins, minerals, energy giving fat and lactose. It is 4-6 times more nutritious than milk in terms of per unit weight and calorific value. (Shalini *et a*l., 2015).

*Kalakand* also known as Qalaqand or Kalakanu which is a popular Indian sweet made up of solidified, sweetened milk. *Kalakand* was invented in 1947 by Baba Thakur Das in Alwar, Rajasthan, India. *Kalakand* is made in Indian subcontinent during different festivals and celebrations. It is most popular in the northern and eastern India, particularly with Bengali people. It is one of the famous traditional milk product in milk rich Braj area of Uttar Pradesh, Jharkhand and Odisha in India (Pawar, 2016).

*Kalakand* has specially importance in various celebration like wedding, inaugural functions, birthday, raksha bandhan and diwali period. Several varieties of *kalakand i.e.* strawberry *kalakand*, ash gourd *kalakand*, sapota *kalakand*, fig *kalakand*, mango *kalakand*, safflower milk *kalakand*, plain *kalakand* etc.

Fruit are invariably used for flavouring of several dairy products. However, due to the presence of phyto-chemicals in most of the fruits, its involvement has increased looking at the wellnesses of the product containing it. Fruits are rich sources of various important phyto-nutrients namely, vitamins, minerals, antioxidants and

dietary fibers. Incorporation of fruits in milk products not only aid in ‘value-addition’ and ‘product diversification’ but also helps in checking the post harvest losses. Typical examples related to inclusion of fruit solids in dairy based products include *burfi, kalakand, pedha, rabri, basundi*, ice cream and frozen desserts, stirred yoghurt, fat spreads, etc. (Agrawal and Goyal, 2017).

Kinnow is a member of Rutaceae family that belong to order Sapindales and class magnoliopsida. Kinnow has 3$^{rd}$ rank after banana and mango. Indian states like Panjab, Haryana, Rajasthan, Himachal Pradesh, Jammu and Kashmir are major growing regions. Kinnow has origin in South East Asia. Worldwide, it is well known for its medicinal properties and nutrients rich juice (Chopra *et al*., 2004; Kelebek *et al*., 2008). Kinnow juice is good source of vitamin-C and various antioxidant compounds that are require to sustain healthy lifestyle. Kinnow juice have received much attention particularly due to presence of anti-cancerous, antioxidant and antimicrobial properties. Kinnow is cheap industrial fruit crop which is easily available in the fruit market (Hayat *et al*., 2010; Nasir *et al*., 2016; Arruda *et al*., 2018; Barrels *et al*., 2018;). fruit are rich in bio-active compounds and their health benefiting properties such as diabetes, prophylaxis of cardiovascular disease, early aging issue allergies and other chronic disorder (Andrade *et al*,. 2019; Ali *et al*., 2019).

Kinnow is a hybrid of two citrus cultivars 'King' (Citrus nobilis) × 'Willow Leaf' (Citrus × deliciosa). Popularly known as Punjab's king of fruits. Kinnow is known as dual purpose horticultural crop which could be used as both food and feed. It is promising natural source of specific mineral (pottasium, magnesium, calcium, zinc, manganese and copper) and bio-active compounds such as vanillic acid, gallic acid, *p*-Coumaric acid, *p*-hydroxy benzine, ferulic acid, catechin, hesperidin, naringenin, quercetin, caffeic acid, kaempferol and chlorogenic acid which make it as important as medicine. Therefore kinnow could be recommended as important fruit which could be used in natural form to combat diseased condition (diabetes, blood pressure, cancer and oxidative stress-related disorders).

Hence, considering the benefits of fruits in the human diet with respect to its nutritional, medicinal values and technological properties, it was decided to undertake

research work on, “Studies on Preparation of *kalakand* with addition of kinnow juice” with following objectives.

### 1.1 Objectives

1. To standardize the process for preparation of *kalakand* with addition of kinnow juice.
2. To determine physico-chemical and sensory properties of *kalakand* with addition of kinnow juice.
3. To Determine the shelf life of *kalakand* with addition of kinnow juice.
4. To estimate the production cost of *kalakand* with addition of kinnow juice.

# CHAPTER-II

# REVIEW OF LITERATURE

## CHAPTER - II

# REVIEW OF LITERATURE

*Kalakand* is one of the popular sweets of Bengali people and now a days being introduced in all parts of country. As a result there is a large variation in the quality of the product from place to place. Several varieties of *kalakand* are available in market *viz*. Plain *kalakand*, kashmiri *kalakand*, fruit *kalakand*, spices *kalakand* etc. The availability of information related to research work on utilization of kinnow juice for preparation of *kalakand* is scanty. The research work is carried out on Preparation of *kalakand* with addition of kinnow juice.

This chapter deals with an exhaustive review of published information on various aspects of *kalakand* which was presented under the following headings.

2.1 Definition of *kalakand.*
2.2 Use of Coagulant.
2.3 Manufacture of *kalakand.*
2.4 Browning in *kalakand.*
2.5 Value addition of *kalakand.*
2.6 Sensory evaluation of *kalakand.*
2.7 Chemical Composition of *kalakand.*
2.8 Yield of *kalakand.*
2.9 Shelf life of *kalakand.*
2.10 Cost of Production of *kalakand.*
2.11 Nutritional quality of Kinnow.

### 2.1 Definition of *kalakand*

*Kalakand* is partially desiccated milk product with caramelized flavour and granular texture prepared from acidified milk (David, 2009).

*Kalakand* is one of the indigenous milk product obtained by heat desiccation/concentration of whole standardized milk with subsequent addition of sugar and proper coagulant or by heating a mixture of *Khoa* and sugar with continues stirring until characteristic flavour develops (Muley and Landge, 2012).

*Kalakand* is a milk sweet basically prepared from *Danedar* variety of *khoa*. *Kalakand* is characterized by large sized hard grains with less cohesive body.

## 2.2 Use of Coagulant

Dharampal and Gupta (1985) studies on preparation of *kalakand* by using citric acid. He reported that desirable *Khoa* could be obtained by either adding small amount of citric acid (0.02 per cent) to milk at the time of boiling or using milk of slightly higher acidity (0.18 to 0.20 per cent lactic acid).

Kumar *et al*., (1993) studied that significantly higher moisture content was observed in *chhana* made by coagulating milk with lactic acid as compared to citric acid.

Suresh and Jha (1994) worked on the manufacturing process for *kalakand*. Three coagulants were used viz., citric acid @ 0.01, 0.02 and 0.03 per cent. Aged whey @ 1, 2 and 3 per cent and alum @ 0.017, 0.035 and 0.053 per cent were used. *Kalakand* made with citric acid @ 0.02 per cent was rated highly acceptable followed by the samples made with aged whey and alum. Samples prepared by using aged whey @ 3 per cent were criticized for stickiness, irregular size, browning, lack of compactness and inferior colour. The samples made with 0.01and 0.03 per cent citric acid possessed loose texture with oozing of syrup. The chewiness, gumminess values were highest in *kalakand* samples made with 0.02 per cent citric acid, the cohesiveness was more or less same in all the samples, irrespective of type of coagulant used.

Muley and Landge (2012) presumed that the addition of appropriate amount of coagulant *i.e.* citric acid and sugar is also very important. As these factors affect the texture and taste of the product. Uses of other coagulant also suffer the overall quality and acceptability of *kalakand*. The milk is standardized to 6 per cent fat and use 0.02per cent citric acid increases sensory quality of product. But milk with 7 per cent fat has more sensory score and acceptability than the milk of 6 per cent fat. It was noted further that citric acid @ 0.02 per cent product best quality *kalakand.*

## 2.3 Manufacture of *kalakand*

De (1982) presumed that the recipes for a few Indian milk sweets that following proportion of ingredients were used for manufacture of *kalakand*.

**Table 2.1: Ingredients used for the preparation of *kalakand***

| Sr. No. | Ingredients | Quantity |
|---|---|---|
| 1. | Milk | 1kg |
| 2. | Sugar | 60g |
| 3. | Citric acid | 0.5g |
| 4. | Pista | A few pieces |
| 5. | Silver paper | A leaf |
| 6. | Cardamom | A few sticks |

De (1982) have described the traditional method, followed commonly by the unorganized sector, for manufacture of *kalakand* by placing specific quantity of milk in a *Karahi* over a brisk and non-smoky fire and brought to boil. It was stirred continuously with a *Khunti* in circular motions. After 20-25 minutes the required amount of citric acid as a dilute solution in water is added. The milk was coagulated partially. At this time, vigorous stirring was required to obtain a product of good quality. When a semi solid stage was reached, the sugar was added and stirred well. Desired quantity of crushed cardamom was incorporated. Then keep it on low heat for five minutes. The finished product was set in greasy trays. It was allowed to cool at room temperature. *Kalakand* was decorated if desired, with silver paper and pista. Cut into required size and shape to be served.

Dharampal and Gupta (1985) mentioned that *Khoa* was the base for preparation of *kalakand*. Depending on the end use, three types of *Khoa* viz. *pindi*, *dhap* and *danedar* were manufactured. *Danedar Khoa* was used for making *kalakand* in which presence of big grains with slightly brown coloration were considered desirable attributes. The attributes could be developed in *Khoa* by either adding small amounts of citric acid (0.02 per cent) in milk at the time of boiling or using milk of slightly higher acidity (0.18 - 0.20 per cent). The resultant product had hard and big grains. It was further revealed that buffalo milk was preferred for making *Khoa*

because it resulted in a product having the above desirable sensory attributes and higher yields.

Suresh and Jha (1994) optimized the process for *kalakand* manufacture and extension of its shelf-life. The buffalo milk was standardized to 6.0 per cent fat and 9.0-9.5 per cent solid-not-fat. After filtration, milk was boiled for 1 min with successive addition of citric acid @ 0.02 per cent w/v. The contents were desiccated up to 30 per cent moisture in double jacketed steam kettle using steam at 20 psi. Sugar was added @ 7.0 per cent w/v followed by further desiccation for 10 min using steam at 10 psi. *Kalakand* was set in greased trays, cooled to room temperature (25-30°C), cut, packaged and stored.

Gothwal and Shukla (1995) described the preparation of *kalakand* by standardizing milk to 4.5 per cent fat and 8.5 per cent SNF. The standardized milk was concentrated in an open *Karahi* (iron pan) over the brisk fire with continuous stirring and scraping of the sides of the pan to prevent the scale formation and subsequent charring. Sugar at a level of 35 per cent was added when the brix was between 66-68°. The processing was monitored by using hand refractometer. At the optimum solid concentration the product was removed and spread evenly on stainless steel plates, cooled over night and cut into bits.

Chavan (2001) prepared *kalakand* from goat milk using two different coagulants *i.e.* citric acid and alum at the rate of 0.02, 0.03 and 0.04 per cent of milk and heating it till semi-solid consistency along with addition of sugar and cardamom and mixed well.

Sawant *et al*., (2007) prepared *kalakand* by replacing 10 per cent ($T_1$) and 20 per cent ($T_2$) milk by mango pulp. Control ($T_0$) was taken as without any replacement of milk. The overall acceptability was rated as 8.94, 8.88 and 8.46 in the treatment $T_0$, $T_1$ and $T_2$, respectively. Proximate analysis of the product indicated the increasing trend of total solids, carbohydrate, ash content as the proportion of mango pulp increased. Fat, protein and acidity of product decreasing with addition of mango pulp.

Bhutkar *et al*., (2015) reported that the *kalakand* was prepared by replacing different level of Ash gourd pulp *i.e.* 0, 5, 10, and 15 parts in cow milk. Cow milk was filtered through muslin cloth and standardized on 4 per cent fat. Milk was converted

into *chhana*. The calculated amount of ash gourd pulp and sugar @ 30 per cent of *chhana* were added. Finally the mixture was heated on a low fire with stirring till the desired texture was obtained. Finally spread in trays. On an average the ash gourd *kalakand* was found to be the overall acceptability score for $T_1$, $T_2$, $T_3$ and $T_4$ was 8.0, 8.25, 8.37 and 8.12, respectively.

David (2015), made an attempt to use Maltodextrin as a fat replacer which being a carbohydrate (very low in fat) is used for manufacturing dietetic *kalakand*. First of all, buffalo milk containing 6% fat and 9% SNF was used as control ($T_0$) and for experimental treatments skim milk was standardized with 0.5% fat and 8.7% SNF together with 1% maltodextrin ($T_1$), skim milk and 2% maltodextrin ($T_2$) and skim milk and 3% maltodextrin ($T_3$) were used. Milk was heated up to boiling temperature and 0.01 % citric acid was added to obtain pat stage. Then sugar was added @ 7% of milk along with cardamom and pista. The finished product was set in a greasy tray and allowed to cool at room temperature. It was then cut into desired size and shape.

Shalini *et al.*, (2015) made an attempt to develop *kalakand* blended with papaya in different concentrations by using whole milk. *Kalakand* was prepared by using four different levels of papaya pulp, $T_0$ treatment was made from buffalo milk (100%) without addition of papaya where as experimental sample of *kalakand* treatment $T_1$ was blended with 15% of papaya pulp, $T_2$ with 25% of papaya pulp and $T_3$ with 35% of papaya pulp with same sugar level (6 %). Milk was pour into pan and boiled at 70 to $80^0$C, continuous stirring by wooden scoop in circular motion of the heating surface. Add 0.02 % of citric acid for coagulation. When the product reached semi solid condition the concentration of heating was reduced 6 % sugar was added, and constantly stirring the product. After moisture lost add papaya pulp on the based on treatment. Finally completed the stirring process product transfer to greased tray for cooling and setting at room temperature.

Kumar and Singh (2017), an attempts was made to develop *kalakand* by addition of Wood apple pulp at different level of concentration using buffalo milk. The pulp combination was incorporated at 0 per cent, 5 per cent, 10 per cent and 15 per cent level (replacing *chhana*). Buffalo milk was filtered through muslin cloth and standardized to 6 per cent fat and 9 per cent SNF. Then the milk was boiled. At the appearance of first boiling, 0.05 per cent citric acid (on volume of milk) dissolved in

small quantity of water is added to milk. Milk was converted in *chhana*. The calculated amount of wood apple pulp and sugar @ 30 per cent of *chhana* were added. Finally the mixture was heated on low fire with continuous stirring till the desired texture was obtained.

Verma *et al.,* (2018) conducted a study to find out the quality parameters of *kalakand* prepared by addition of coconut milk and sapota at different level of concentration (*i.e.* $T_0$, $T_1$, $T_2$ and $T_3$) using buffalo milk. The concentration of coconut milk and sapota in experimental samples were 15% & 5% for treatment $T_1$; 10% & 10% for treatment $T_2$ and 5% & 15% for treatment $T_3$ respectively. While control sample $T_0$ was prepared from 100% of buffalo milk. The concentration of sugar was 6% which was constant for all the treatments.

Thikare (2020), an attempt was made to develop *kalakand* by addition of strawberry pulp at different level of concentration using cow milk. Preparation of *kalakand* from fresh cow milk standard method described by De (2015) was followed with slight modification. Looking to diversified benefits of strawberry and nutritional quality value of cow milk, strawberry pulp *kalakand* was prepared from cow milk *khoa* with various treatment combinations. The treatment details were $T_1$ (70 part of cow milk *khoa* +30 part of sugar), $T_2$ (65 part of cow milk *khoa* + 5 part of strawberry pulp +30 part of sugar), $T_3$ (60 part of cow milk *khoa* + 10 part of strawberry pulp +30 part of sugar), $T_4$ (55part of cow milk *khoa* + 15 part of strawberry pulp +30 part of sugar), $T_5$ (50 part of cow milk *khoa* + 20 part of strawberry pulp +30 part of sugar) with five replications.

## 2.4 Browning in *kalakand*

Suresh and Jha (1994) sensory, biochemical and microbiological qualities of *kalakand*. The presence of sulphydryl and hydroxymethylfurfural (HMF) groups indicated a greater extent of browning in market *kalakand* samples.

Gothwal and Shukla (1995) revealed that the effect of refined wheat flour (*maida*), at a level of 8 %, increased browning index (20 to 22%) during heat treatment in both cow and buffalo milk. At 10 per cent level, *maida* caused an increase in browning index in *kalakand* (13 per cent). Milk with sugar at 6, 8 and 10 per cent level sterilized at 1.05 kg/cm2 for 15 minutes showed no browning in

*kalakand* through prolonged heating. Sugar at 15- 35 per cent based on the weight of *khoa*, produced less browning in *kalakand*. Higher total solids tended to increase browning in *khoa* and *khoa*-based sweet preparation.

Sarkar & Ghatak (2001) studies on the chemical quality of market and laboratory made *burfi.* They reported that the sulphur dioxide released from these preservatives ($Na_2S_2O_5$ and $K_2S_2O_5$) delayed browning in treated *burfi*.

Montukumar P. (2014) shelf life study of *kalakand* prepared using amla powder and stored under modified atmospheric packaging. Irrespective different packaging system studied HMF (µ mole/100g), the reaction products for maillard browning was found to be increase during storage of *kalakand* at 20±2 °C temperature as well as refrigeration temperature (7±2 °C).

## 2.5 Use of fruits in preparation of *kalakand*

Dongale *et al.*, (2008) studied the preparation of *kalakand* fortified with mango pulp. The *kalakand* was prepared by using two types of milk *viz*. cow milk ($T_1$) and buffalo milk ($T_2$), with three levels of mango pulp ($L_1$-5%, $L_2$- 10% and $L_3$-15%) and trial was conducted with six replications. From overall acceptability it is clear that buffalo milk was superior to cow milk for preparation of *kalakand* with or without mango pulp.

Bhutkar *et al*., (2015) made an attempt to develop *kalakand* by addition of ash gourd pulp at the different level $T_1$- 0 parts of ash gourd pulp + 100 parts of *chhana* by weight, $T_2$- 5 parts of ash gourd pulp + 95 parts of *chhana* by weight , $T_3$- 10 parts of ash gourd pulp + 90 parts of *chhana* by weight, $T_4$- 15 parts of ash gourd pulp + 85 parts of *chhana* by weight with the addition of sugar @ 30% (by weight of *chhana*) and the addition of citric acid @ 1 % by volume of milk. The overall acceptability was rated as 8.0, 8.25, 8.37 and 8.12 in the treatment $T_1$, $T_2$, $T_3$, and T4 respectively. Protein, carbohydrate and ash content in the finished product were decreased with increase in ash gourd pulp.

Shalini *et al*., (2015) made an attempt to develop *kalakand* by addition of papaya pulp at different level of concentration using buffalo milk. Experimental sample of *kalakand* treatment $T_1$ was blended with 15% of papaya pulp, $T_2$ with 25% of papaya pulp and $T_3$ with 35% of papaya pulp. According to analysis treatment $T_3$

with 35 % of papaya pulp was found best among three. Thus product acceptability was rated as $T_3 > T_2 > T_1 > T_0$.

Kumar and Singh (2017) made an attempt to develop *kalakand* by addition of Wood apple pulp at different level of concentration using buffalo milk. The pulp combination was incorporated at 0 per cent, 5 per cent, 10 per cent and 15 per cent level (replacing *chhana*).According to the analysis, treatment $T_3$ with 15 per cent wood apple pulp combination was found best. The overall acceptability judged by organoleptic evaluation and therapeutic value, the treatment was rated as $T_3 > T_2 > T_1 > T_0$.

Verma *et al*., (2018) made an attempt to develop *kalakand* by addition of coconut milk and sapota at different level of concentration using buffalo milk. The concentration of coconut milk and sapota in experimental samples were 15% & 5% for treatment $T_1$; 10% & 10% for treatment $T_2$ and 5% & 15% for treatment $T_3$ respectively. While control sample $T_0$ was prepared from 100% of buffalo milk. According to the analysis, treatment $T_1$ with 15% Coconut milk and 5% Sapota was found to be the best among all. The overall acceptability can be rated as 7.5, 8.0, 8.4 and 8.9 in the treatment $T_1$, $T_2$, $T_3$ and $T_4$ respectively.

Thikare *et al*., (2020) studied the effect of different levels of strawberry pulp (*Fragaria ananassa*) on physico-chemical quality of *kalakand*. The treatment details were $T_1$ control (70 part of cow milk *khoa* +30 part of sugar), $T_2$ (65 part of cow milk *khoa* + 5 part of strawberry pulp +30 part of sugar), $T_3$ (60 part of cow milk *khoa* + 10 part of strawberry pulp +30 part of sugar ), $T_4$ (55 part of cow milk *khoa* + 15 part of strawberry pulp +30 part of sugar), and $T_5$ (50 part of cow milk *khoa*+ 20 part of strawberry pulp +30 part of sugar). In short total sugar, total solids, fat, protein and pH were normally decreased while moisture, ash and acidity were increased with increase in levels of strawberry pulp.

## 2.6 Sensory evaluation of *kalakand*

Dongale *et al*., (2008) revealed that the Preparation of *kalakand* fortified with mango pulp. The overall acceptability score was determined on the basis of average of the total score obtained for different sensory attributes *viz*. general appearance, body and texture, and flavour. The higher acceptability score of 7.50 was recorded at 15 per

cent level of mango pulp, at the level the product was showed attractive yellowish colour of mango and typical appealing flavour of alphanso. *Kalakand* prepared from cow and buffalo milk did not have significant variation in respect of appearance and flavour. Where as in respect of body and texture, buffalo milk *kalakand* had acceptable bigger grains with better appeal. The highest overall acceptability score was recorded for *kalakand* prepared from buffalo milk (7.36).

Soni J. (2010) presumed that the preparation of beverage from kinnow (Citrus reticulata) juice and whey. She reported that the blend containing 80% kinnow juice, 15% TSS and 20% whey was found to have highest overall acceptability (7.97). The acceptability of the product did not effect on organoleptic quality.

Wadewale D. M. (2010) an attempt to develop mandarin orange (Citrus reticulata) *burfi* and revealed that mandarin orange burfi with treatment $T_2$ (10 parts of mandarin orange juice) resulted in to a product of better choice and with the highest score rating of colour and appearance (8.62), body and texture (8.15), flavour (8.16), taste (8.41) and overall acceptability (8.33).

Mann S. (2011) preparation of ice cream incorporating kinnow peel and revealed that ice cream with candied kinnow peel had higher taste score (8.2) followed by ice cream with fresh (7.9), dried (7.5) and frozen (7.4) kinnow peel. The aroma score were higher for ice cream with candied (8.3) and fresh (8.2) kinnow peel. The body and texture score were similar in candied and frozen (8.1) while in dried (7.9) and fresh (7.8) kinnow peel, respectively.

Bhutkar *et al*., (2015) presumed that the value added *kalakand* using ash gourd pulp. He studied that the sensory score of flavour 8.00 to 8.50, body and texture 8.00 to 8.50, sweetness 8.00 to 9.00, colour and appearance 8.00 to 8.50 and overall acceptability 8.00 to 8.37.

Shalini *et al*., (2015) an attempts to develop papaya pulp *kalakand* and revealed that the treatment $T_3$ with 35% of papaya pulp was found best among three in respect of all sensory parameter. Thus product acceptability was rated as $T_3 > T_2 > T_1 > T_0$.

Kumar and Singh (2017) presumed that the Formulation and evaluation of wood apple supplemented *kalakand*. The sensory score of flavour and taste 7.20±0.05

to 8.60±0.05, colour & appearance 7.30±0.03 to 8.30±0.06, body & texture 7.90±0.04 to 8.40±0.05, overall acceptability 7.40±0.05 to 8.48±0.04 respectively.

Thakur *et al*., (2017) the study was made with an attempts to develop the value added *kalakand* using custard apple. Custard apple *kalakand* sample ($T_1$) prepared by addition of 4% custard apple pulp, 5% sugar secured maximum score(8.75) and was most acceptable than the other treatment samples.

Verma *et al*., (2018) presumed that the preparation of *kalakand* by using buffalo milk blended with coconut milk and sapota. He revealed the sensory score of flavour and taste 7.3 to 8.9, body and texture 7.2 to 8.7, colour and appearance 7.6 to 8.8 and overall acceptability 7.5 to 8.9. According to the analysis, treatment $T_1$ with 15% coconut milk and 5% sapota was found to be the best among all. Thus, product acceptability judged by organoleptic evaluation and therapeutic value, the treatment can be rated as $T_1 > T_2 > T_3 > T_0$.

## 2.7 Chemical composition of *kalakand*

Magadum (1979) found that the average composition of *kalakand* from cow milk, buffalo milk and mixed milk as under.

| Constituent (%) | Cow milk | Buffalo milk | Mixed milk |
|---|---|---|---|
| Total solids | 83.84 | 85.63 | 85.71 |
| Moisture | 14.37 | 16.16 | 14.29 |
| Fat | 15.82 | 23.63 | 14.25 |
| Acidity | 0.31 | 0.31 | 0.32 |

Ramole (1986) found that the average chemical composition of *kalakand* from fresh cow milk and high acid milk.

| Constituent (%) | Cow milk | High acid milk |
|---|---|---|
| Moisture | 24.23 | 25.17 |
| Total solids | 75.76 | 74.82 |
| Protein | 15.31 | 15.40 |
| Fat | 14.13 | 14.64 |
| Sucrose | 27.43 | 27.35 |
| Lactose | 15.19 | 14.53 |
| Ash | 02.59 | 2.56 |
| Acidity | 0.32 | 0.34 |

Arora *et al*., (1991) concluded that the collection 67 sample of *kalakand* aseptically in pre-sterilized container from different market centers of India and tested for its chemical and microbiological properties. They revealed that the very wide variation in chemical composition and microbial quality of the sample. Further they presumed that this type of variation is due to unhygienic condition of handling, manufacturers and storage. Overall chemical composition of *kalakand* sold in different market of India was as under.

| Constituent (%) | Maximum | Minimum | Average |
|---|---|---|---|
| Total solids | 84.75 | 63.59 | 77.60 |
| Protein | 17.97 | 09.40 | 13.40 |
| Fat | 26.46 | 04.75 | 17.32 |
| Sucrose | 42.12 | 15.38 | 27.96 |
| Lactose | 21.90 | 11.87 | 16.64 |
| Ash | 03.48 | 01.78 | 02.53 |
| Acidity | 0.70 | 0.26 | 0.39 |

Dongale *et al.*, (2008) revealed that the *kalakand* fortified with mango pulp. The average chemical composition range is 27.73 to 31.24 moisture, 68.76 to 72.27 total solids, 21.39 to 24.72 fat and 0.37 to 0.47 per cent titratable acidity respectively.

Bhutkar *et al*., (2015) found that the average chemical composition of ash gourd *kalakand*. The moisture range between 17.04 to 28.75, carbohydrate 38.40 to

31.61 per cent, fat 24.80 to 21.12, protein 14.04 to 16.65, ash 2.10 to 1.87 per cent respectively.

David (2015) concluded that the average chemical composition of maltodextrin were used along with skim milk to manufacture *kalakand*. The moisture range between 15.09 to 20.05, total solids 79.75 to 84.91, fat content 1.30 to 16.98, acidity 0.09 to 0.15 and yield is 22.20 to 26.04 respectively.

Kumar and Singh (2017) presumed that the average chemical composition of wood apple *kalakand* range is 75.68±0.34 to 82.97±0.36 total solids (%), 21.38±0.34 to 25.12±0.26 fat (%), 15.09±0.51 to 17.45±0.56 protein (%), 36.75±0.46 to 37.73±0.52 carbohydrate (%), 2.46±0.09 to 2.67±0.10 ash (%) and 0.61±0.04 to 0.76±0.04 titratable acidity (%).

Thakur *et al*., (2017) presumed that the average chemical composition of custard apple *kalakand* of treatment $T_0$, $T_1$, $T_2$ and $T_3$ contained 73.60, 74.35, 75.43, 77.25 per cent total solids, 26.47, 25.65, 24.60 and 24.86 per cent moisture, 20.06, 19.68, 18.89 and 17.59 per cent fat, 15.36, 15.11, 14.90 and 14.30 protein, 15.28, 15.10, 14.76 and 14.63 per cent lactose, 26.20, 25.65, 25.40 and 23.30 per cent sucrose, 0.36, 0.30, 0.28 and 0.27 per cent acidity, 2.43, 2.70, 2.82 and 3.10 per cent ash respectively.

Verma *et al.*, (2018) found that the *kalakand* prepared by using buffalo milk blended with coconut milk and sapota. The moisture range between 21.09 to 25.14 , carbohydrate 32.22 to 36.59, fat 2.51 to 2.67, protein 14.47 to 16.91, total solid 74.38 to 78.69 and acidity 0.57 to 0.67 per cent respectively.

Thikare *et al*., (2020) presumed that the moisture content of strawberry *kalakand* was 26.22, 28.92, 29.79, 30.44 and 31.47 per cent, total solids content was 73.51, 71.08, 70.21, 69.65 , fat content was 21.14, 20.11, 19.22, 18.04 and 17.14 per cent, protein content was 16.38, 15.69, 15.01, 14.31 and 13 per cent, total sugar content was 35.74, 33.13, 32.54, 30.29 and 29.13 per cent, ash content was 2.64, 2.75, 2.86, 2.95 and 3.06 per cent, and 68.53 per cent, acidity content was 0.55, 0.60, 0.65, 0.70 and 0.75 per cent, pH content was 6.37, 6.34, 6.33, 6.30 and 6.29 for the treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively. He found that the total sugar, fat, total

solids, protein and pH were normally decreased while moisture acidity and ash were increased with increase in levels of strawberry pulp.

## 2.8 Yield of *kalakand.*

Magadum (1979) reported that the yield of *kalakand* was 32.08, 23.81 and 22.41 per cent from buffalo, cow and mixed milk respectively.

Ramole (1986) presumed that the yield of *kalakand* was 22.85 per cent and 23.03 per cent from fresh milk and high acid milk respectively.

David (2015) concluded that the maximum yield of *kalakand* was obtained for treatment $T_0$ (control) (26.04) followed by $T_3$, $T_2$ and $T_1$ contained 23.96, 23.08 and 22.20 respectively.

## 2.9 Shelf life of *kalakand.*

Magadum (1979) presumed that the samples of *kalakand* stored for 21 days at ambient temperature and refrigerated temperature (0-100°C). All samples were packed in different packages *i.e.* polyethylene bags, parchment paper and card board box. After 21 days of storage he revealed that all the samples packed in parchment paper and card board box showed marked increase in total solids and fat and scored high in organoleptic quality in contrast with the samples packed in polyethylene bag and parchment paper. The bacteriological quality was also poor in all samples packed in polyethylene bag and parchment paper.

Suresh and Jha (1994) were successful in increasing the shelf life of potassium sorbate added *kalakand* up to 15 days at 37°C and 24 days at 30°C respectively.

Moulick *et al*., (1999) were increased the shelf life of potassium meta bisulphite added *kalakand* up to 6 days and 26 days respectively at 30°C and at 7°C.

## 2.10 Cost of Production of *kalakand.*

Sawant *et al*., (2006) concluded that the cost of *kalakand* production was decreased simultaneously with increase in level of sapota pulp. The cost of *kalakand* production at $T_0$, $C_1$ and $C_2$ levels were 81.53, 78.34 and 76.39 respectively. He revealed that the cost of production that as the proportion of sapota pulp increased, cost of production was decreased.

Dhanwade *et al.*, (2006) found that, the cost of production of 1 kg *kalakand* from buffalo milk was considerably higher Rs. 68.5 as compared to the cost of production of treatment $T_1$-Rs.57.38, $T_2$-Rs.53.72 and $T_3$- Rs.50.19. There was a considerable decrease in cost of the product with the addition of safflower milk.

Bhutkar *et al.*, (2015) presumed that the cost of *kalakand* production at $T_1$-Rs.356, $T_2$- Rs.343, $T_3$- Rs.331, $T_4$- Rs.318 respectively. There was a considerable decrease in cost of the product with the addition of ash gourd pulp.

Verma *et al*., (2015) presumed that the cost of production of final product for treatments $T_0$, $T_1$, $T_2$ and $T_3$ were 209, 222.57, 221.95 and 218 Rs. / Kg respectively.

**2.11 Nutritional quality of Kinnow juice**

Kinnow juice is a rich source of primary metabolites such as amino acid, vitamins (ascorbic acid, provitamin-A, and folate) as well as secondary metabolites such as bio-active compounds limonoids, flavones, phenolics, and flavonoids and carotenoids. The amount of amino acids present in kinnow juice depends on the storage conditions such as temperature and humidity of storage chamber. Major amino acid present in kinnow juice are asparagine (3.5 μmol/g) followed by arginine (2.4 μmol/g), aspartic acid (2.0 μmol/g), proline (1.5 μmol/g), and glutamine (1.0 μmol/g) (Matsumoto and Ikoma, 2012). Kinnow juice is an important source of osmotic stabilizer and blood pressure regulating minerals (potassium and sodium). Pottasium concentration in kinnow juice may vary from1.6 to 2.5 mg/g whereas Sodium ranged from0.01 to 0.03 mg/g. Mineral profile of kinnow juice indicates the presence of calcium in range (0.14–0.47 mg/g) followed by magnesium (0.11–0.12 mg/g), phosphorus (0.10–0.30 mg/g), iron (0.0015–0.0060 mg/g), zinc (0.0007–0.005 mg/g), copper (6–8 mg/100 ml), and manganese (0.0005 mg/g) (Barros *et al*., 2012).

**Table 2.2: Chemical composition of kinnow mandarin juice.**

| Parameter | Value |
|---|---|
| pH | 3.9 |
| Total suspended solids (TSS)expressed as Brix ($^{o}$) | 12.1 |
| Acidity (%) | 0.88 |
| Reducing sugars (%) | 5.76 |
| Limonin | 0.35-0.53 |
| Naringin | 250 |
| Vitamin C | 123 |
| Water (%) | 80 |

*Expressed as mg/100 ml (Puri and Munish; 2002).

Bhardwaj and Mukherjee (2011) reported that the kinnow juice contains TSS (11.50 $^{0}$B), Acidity (0.76), ascorbic acid (21.15 mg/100 ml of juice), total sugars (7.50%), limonin (0.22 mg/100 ml of juice) and non-enzymatic browning (0.08).

# CHAPTER-III

# MATERIALS AND METHODS

## CHAPTER - III

# MATERIALS AND METHODS

During the course of present investigation on the "Studies on Preparation of *Kalakand* with addition of kinnow juice'' the material used and method employed are as under.

### 3.1 Materials:

#### 3.1.1 Buffalo milk

The whole, fresh, clean buffalo milk was received from buffalo unit, Department of Animal Husbandry and Dairy Science, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the course of plan of present studies.

#### 3.1.2 *Karahi*

The *karahi* with a small, shallow, open rounded bottomed iron pan, fitted with two looped handles, with a capacity to hold four liters of milk was used for the desiccation of milk.

#### 3.1.3 *Khunti*

The iron *Khunti* having long handle and flattened end with a relatively sharp edge was used for stirring cum-scrapping the milk.

#### 3.1.4 Kinnow juice

Kinnow procured from the local fruit and vegetable market were washed, peeled and the juice extracted by using juicer.

#### 3.1.5 Sugar

Clean crystalline sugar purchased from local market was used as an ingredient of *kalakand* as sweetening and thickening agent and was grind by using a mixer.

### 3.1.6 Citric acid

AR grade citric acid (Qualigens) was obtained from ELP Laboratory**.**

### 3.1.7 Weighing balance

Electronic precision balanced was used for weighing samples, chemicals and ingredients etc. throughout the experimental period.

### 3.1.8 Chemicals

Analytical reagent grade chemicals were used for the chemical analysis of *kalakand* sample.

### 3.1.9 LPG burner

Source of heating of milk concentrate during preparation of *kalakand*.

### 3.1.10 Glassware

Borosil glassware's were used for the chemical analysis of *kalakand* sample.

### 3.1.11 Mixer-cum-grinder

Electric mixer-cum-grinder available in ELP laboratory was used for grinding of sugar.

## 3.2 Method

### 3.2.1 Treatment details:

Preparation of *kalakand* with addition of kinnow juice following treatment combinations was taken for study:

$T_1$= 100 parts of buffalo milk + 0 parts of kinnow juice.

$T_2$= 90 parts of buffalo milk + 10 parts of kinnow juice.

$T_3$= 85 parts of buffalo milk + 15 parts of kinnow juice.

$T_4$= 80 parts of buffalo milk + 20 parts of kinnow juice.

$T_5$= 75 parts of buffalo milk + 25 parts of kinnow juice.

In above all preparation, sugar was added @ 6 % of original volume of milk.

### 3.2.2 Preparation of *kalakand*:

The preparation of *kalakand* from buffalo milk standard method are used given by De (1982) with slight modification.

One litre of buffalo milk was accurately measured and poured in a clean and dry iron *karahi.* It was placed over a non smoky fire for direct heating. Milk was continuously stirring with *khunti* in a rotational motion. After boiling of required quantity of diluted citric acid was added into the milk for partial coagulation. At this stage, vigorous stirring was done to obtain a good quality product. Make semisolid consistency through continues stirring during heating. At this stage, addition sugar (cane sugar) powder @ 6 per cent and crushed cardamom @ 0.02 per cent and stirred well for 5 min. The finished product was removed and set in a greasy tray for reduce the chances of stickiness and allow to cool at room temperature. After that the *kalakand* sample were subjected to the sensory evaluation and chemical analysis.

The product was prepared from Buffalo milk, kinnow juice and sugar as per the procedure.

Buffalo milk

↓

Filtration/clarification

↓

Standardization (6 per cent fat)

↓

Boiling of milk (20-25 minutes)

↓

Addition of citric acid @ 0.02 % (w/v of milk)

↓

Stirring till semisolid consistency

↓

Addition of kinnow juice (40°C)

↓

Addition of sugar @ 6 per cent and mix well

↓

Keep on low fire for five minutes with continuous stirring

↓

Setting of *kalakand* in greased trays

↓

Cool and store at room temperature (25-30°C).

**Flow-diagram 3.2.2: Preparation of *kalakand* with addition of kinnow juice.**

### 3.2.3 Sensory evaluation of *kalakand*

Sensory evaluation of *kalakand* was carried out by the panel of judges selected from the staff of Department of Animal Husbandry and Dairy science, College of Agriculture, Parbhani. It was evaluated for colour and appearance, flavour, body and texture, and overall acceptability. Score card was provided to all judges, comparing "9-point hedonic scale" developed by Quarter Master Food and Container Institute, U.S.A. (Gupta, 1976).

**T1**

**T2**

**T3**

**T4**

**T5**

**Plate 1. Various treatments of kinnow juice level in *kalakand***

**Name of judge:-**

**Date :-** **Time :-**

**Numerical values of the score card are as under**

| **Quality grade distribution** | **Score** |
|---|---|
| Like extremely | 9 |
| Like very much | 8 |
| Like moderately | 7 |
| Like slightly | 6 |
| Neither like nor dislike | 5 |
| Dislike slightly | 4 |
| Dislike moderately | 3 |
| Dislike very much | 2 |
| Dislike extremely | 1 |

### 3.2.4 Chemical analysis of *kalakand*

The following procedure were adopted for chemical analysis of *kalakand*.

#### 3.2.4.1 Determination of Moisture

The moisture content of *kalakand* was determined as per procedure of ISI : 1479 (Part-II), ISI-1961.

3.0 gm of *kalakand* sample was weighed in a clean and dried moisture dish. 2-3 ml of hot distilled water was added in the sample to make a paste, which was spread over the entire bottom of the dish. Then dish was placed on a hot plate at 180°C and heated till colour of residue became light brown. The dish was then transferred to the oven at 100°C, where it was heated for 20 minutes under not less than 50 cm of vacuum. Finally the dish was transferred to desiccators (containing calcium chloride) for cooling, followed by subsequent weighing. The heating, cooling and weighing were continued until the constant difference between two subsequent weighings were obtained. The percent moisture in *kalakand* sample was calculated by using the following formula:

$$\text{Moisture (\% by weight)} = \frac{\text{Loss in weight of sample}}{\text{Weight of sample taken}} \times 100$$

**3.2.4.2 Determination of Fat:**

Fat content of *kalakand* sample was determine by Gerber method described in IS: 1224 (Part-II) (1977).

Exactly 3 gm of well mixed *kalakand* sample was weighed in a glass beaker and 3 to 4 ml hot distilled water was added to make the paste. 10 ml dilute sulphuric acid (87:13, acid: distilled water) was then transferred into the same beaker. The contents of beaker were quantitatively transferred into cheese butyrometer followed by washing the beaker content with 1 ml Iso-amyl alcohol and 2 to3 ml hot distilled water and then transferred it to cheese butyrometer. The butyrometer was locked by stopper and the contents were vigorously shaken to digest non fat substances. Liquid level in the butyrometer was brought to calibration by addition of required amount of distilled water. It was then centrifuged in Gerber centrifuge machine for 5 min. Fat column was read tempering butyrometer for 5 min in water bath maintained at 65°C.

**3.2.4.3 Determination of Protein:**

Protein content of *kalakand* was determined by the Micro-kjeldahl method as described in IS: 1479 (Part-II) (1961).

1g of *kalakand* sample was transferred into clean and dry kjeldahl's flask having digestion mixture (98 per cent potassium sulphate + 2 per cent copper sulphate) and then 20 ml concentrated sulphuric acid was poured in the flask. The contents of the flask were gently heated in an inclined position when the initial frothing was ceased. A paper shaped loose stopper in the top of the flask was fitted and the heating was continued strongly on electric coil burner taking care that the liquid boiled moderately. The flask was shaken time to time and heating was continued till liquid become clear or faint blue in colour. The contents were allowed to cool and the digested sample was poured into the distillation flask with 400 ml of distilled water. The receiving flask 5 ml boric acid solution was added with 2 ml of

bromocresol green and methyl red indicator. It was then connected with the distillation apparatus with the delivery tube clipping below the boric acid solution. The diluted digest was made alkaline with 40 per cent NaOH solution, 300 ml distillate was collected and titrated against N/10 sulphuric acid. A blank was run simultaneously.

$$\text{Nitrogen \% (By weight)} = \frac{\text{Sample burette reading} - \text{Blank burette reading}}{\text{Weight of sample}} \times 0.014 \times 100$$

The per cent nitrogen was multiplied by factor 6.38 to obtain protein per cent in the sample.

Protein (%) by weight = per cent Nitrogen x 6.38

**3.2.4.4 Determination of Ash:**

The total ash content of *kalakand* sample was determined by method given by IS: 1479 (Part-II) (1961).

About 5 g of sample was weighed in a previous weighed silica crucible and ignited in muffle furnace maintained at 550°C not more than 3.5 hr or until ash become free from carbon. The crucible was cooled in desiccators and then weighed. The process of ignition cooling and weighing was repeated at half hourly intervals until the differences between two successive weighing was less than 1 mg. The total ash was calculated by following formula:

$$\text{Total Ash (\% by weight)} = \frac{(W1 - W)}{(W2 - W)} \times 100$$

Where,

W = Weight in g of the empty crucible

W1 = Weight in g of the crucible with ash

W2 = Weight in g of the crucible with sample

### 3.2.4.5 Determination of Total solids:

The total solids content of *kalakand* sample was determined by method given in IS: 1479 (Part-II) (1961) procedure.

A clean dry empty porcelain crucible was kept in hot air oven maintained at 100°C for one and half hour then cooled and weighted. Then 3g of *kalakand* sample was weighted quickly. Crucible was placed in a hot water bath for 30 minutes. The crucible was removed and wiped the bottom and transferred to oven maintained at 100°C. After 2 to 3 hours crucibles was immediately removed to desiccators and cooled for about 30 minutes and weighted, the crucible again kept in oven and heated for one more hour and then transferred to desiccator, cooled and weighted as before. This process was repeated till difference between successive weights did not exceed by 0.5 mg.

$$\text{Total solids (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

### 3.2.4.6 Determination of Fiber:

The dietary fiber content of *kalakand* sample was determined by the method as described in AOAC method (1975).

About 2 - 5 g of moisture and fat free *kalakand* samples were weighed into 500 ml beaker and 200 ml boiling 0.255 N (1.25 w/v) $H_2SO_4$ was added. The mixture was boiled for 30 minutes keeping the volume constant by addition of water at frequent intervals. At the end of this period, the mixture was filtered though a filter paper and the residue washed with hot water material then transferred to the same beaker and 200 ml of boiling 0.313 N NaOH solutions was added. After boiling 30 minutes the mixture was filtered through filter paper. The residue was washed with hot water till free from alkali followed with some alcohol. It was then transferred to crucible dried overnight at 80- 100°C and weighed.

$$\text{( \%) Fiber} = \frac{\text{Weight of residue} - \text{Weight of ash}}{\text{Weight of sample}} \times 100$$

### 3.2.4.7 Determination of Total Carbohydrates:

Carbohydrate content of *kalakand* samples were determined by the method described in IS: 1981. It was determined by subtracting fat, protein, ash, moisture content from one hundred.

Carbohydrate = Total solids - (Moisture + Fat + Protein + Ash + Fiber)

### 3.2.5 Physical analysis of *kalakand*

### 3.2.5.1 Acidity

Acidity of product (as per lactic acid) was determined according to the method specified in Part-I of IS: 1479 (ISI, 1960).

Ten-gram *kalakand* sample was taken in a conical flask; it was mixed with 10 ml of distilled Water. 4-5 drops of phenolphthalein indicator were added and titrated again 0.1 NaOH solution. The acidity as percent lactic acid was determined by using following formula.

$$\text{Acidity (\% by volume)} = \frac{\text{Vol. of 0.1 N NaoH required X 0.009}}{\text{Weight of sample}} \times 100$$

### 3.2.5.2 Determination of pH

The pH of *kalakand* was measured by using digital pH meter (335), EUTACH INSTRUMENT firstly the pH meter was standardized at 25℃ by using standard buffer solution. The pH of the sample was observed on the dial and recorded.

### 3.2.6 Microbiological analysis

All the experimental *kalakand* at fresh was analyzed for the Total Plate Count (TPC) by the method described in IS: 5402 (1969), Yeast and Mould Count (YMC) by the method described in IS: 5403 (1999) and Coliform Count by the method described in IS: 1479 (Part III, 1962).

### 3.2.6.1 Total plate count.

Eleven grams of each of the sample was aseptically weighed and transferred into 99 ml sterile citrate buffer (Appendix II) flask. Further dilutions were prepared

using 9 ml sterile citrate buffer blanks. Suitable dilutions (selected based on preliminary study conducted) of each sample was transferred (1.0 ml) aseptically into sterile Petri plates and thereafter 10 to 15 ml of TPCA (total plate count agar) (Appendix II) was added. The plates were incubated in an incubator maintained at 37±0.5ºC for 48 h and the number of colony forming units (cfu) was noted. All the plates were prepared in duplicate IS: 5402 (1969).

#### 3.2.6.2 Yeast and mold count

The yeast and mold count of all the samples was also determined by same method as described in section 3.6.1, except that the medium used was potato dextrose agar and the plates were incubated at 23±10ºC for 5 days IS: 5403 (1999).

#### 3.2.6.3 Coliform count

The coliform count of all the samples was determined by the method as described in section 3.6.1, except that the medium used was violet red bile agar (VRBA), prepared as specified in the IS:1479 (Part III, 1962) and the plates were incubated at 37±0.5ºC for 18 to 24h.

### 3.2.7 Cost estimation of *kalakand* with addition of kinnow juice:

The cost estimation (Rs/kg) of the newly formulated product was worked out by taking into account the prevailing market rates of the ingredients as well as other charges used during manufacture of *kalakand* with addition of kinnow juice.

## 3.3 Statistical Analysis:

The data obtained was analyzed statistically by using Completely Randomized Design (CRD) prescribed Panse and Sukhatme (1985).

## 3.4 Facilities Required and their Availability:

Facilities to carry out research are available at Department of Animal Husbandry and Dairy Science, College of Agriculture, Parbhani. Milk and other ingredient such as Kinnow juice, citric acid, sugar, packing material, etc. was purchased from local market, Parbhani.

# CHAPTER-IV

# RESULTS AND DISCUSSION

## CHAPTER – IV

# RESULTS AND DISCUSSION

The present investigation was aim to addition of kinnow juice in *khoa* to formulate a novel type of *kalakand*. The results obtained during the course of investigation "Studies on Preparation of *Kalakand* with addition of kinnow juice" are presented in the following parameters.

Chemical composition of kinnow juice:

| **Parameter** | **Value/100gm** |
|---|---|
| Moisture (%) | 82 |
| TSS (%) | 11.8 |
| Acidity (%) | 0.88 |
| pH | 4.0 |

4.1 Sensory evaluation of kinnow juice *kalakand*

4.1.1 Colour and appearance

4.1.2 Body and texture

4.1.3 Flavour

4.1.4 Overall acceptability

4.2 Physico-chemical composition of kinnow juice *kalakand*

4.2.1 Moisture

4.2.2 Fat

4.2.3 Protein

4.2.4 Total solids

4.2.5 Total carbohydrate

4.2.6 Ash

4.2.7 Acidity

4.2.8 pH

4.3 Shelf life of *kalakand*

4.4 Cost of production of kinnow juice *kalakand*

## 4.1 Sensory evaluation of kinnow juice *kalakand*

*Kalakand* prepared from buffalo milk with addition of kinnow juice in different combinations were subjected for sensory attributes viz. colour and appearance, body and texture, flavour and overall acceptability characteristics by a semi-trained panel of five judges using 9 - point hedonic scale. The numerical score in tables of different attributes are the mean of five judges for each replication.

### 4.1.1 Colour and appearance of kinnow juice *kalakand*

Colour of any product is ideal and basic sensory cognition that appeals to the consumer for its acceptability or rejection. Colour and appearance score of kinnow juice *kalakand* was determined under different treatment combination. The average score for control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 per cent ($T_2$, $T_4$, $T_4$ and $T_5$) are depicted in Table 4.1 and graphically represented in Figure 4.1.1.

It was apparent from table 4.1 the colour and appearance score for various treatments ranged between 7.69 to 8.57. The score for treatment $T_3$ (8.57) was maximum followed by $T_1$ (8.51), $T_2$ (8.44), thereafter it was decreased from treatment $T_4$ (8.23) and $T_5$ (7.69). The highest acceptable score was for $T_3$ (8.57) which has 15 parts of kinnow juice. The lowest score was obtained for treatment $T_5$ (7.69) with very dull appearance having 25 parts of kinnow juice.

**Table 4.1: Effect of various levels of kinnow juice on Colour and appearance of *kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 8.54 | 8.50 | 8.52 | 8.49 | **8.51$^{a}$** |
| **$T_2$** | 8.47 | 8.43 | 8.45 | 8.42 | **8.44$^{a}$** |
| **$T_3$** | 8.60 | 8.56 | 8.58 | 8.55 | **8.57$^{ab}$** |
| **$T_4$** | 8.41 | 8.37 | 8.39 | 7.74 | **8.23$^{b}$** |
| **$T_5$** | 7.68 | 7.69 | 7.72 | 7.68 | **7.69$^{c}$** |
| **SE ± 0.073391** | | | | **CD at 5 % 0.221225** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

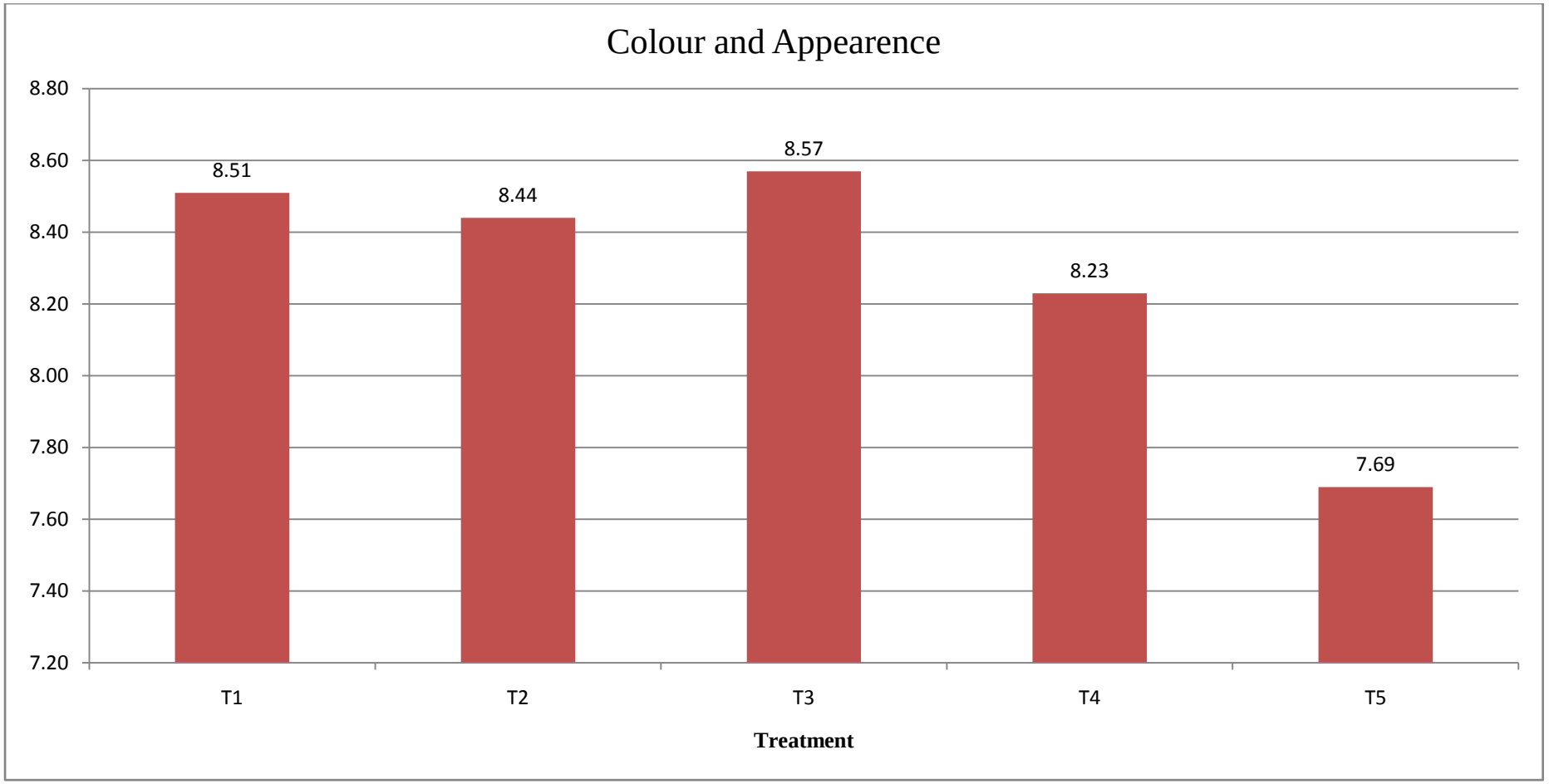


**Figure 4.1.1Effect of various levels of kinnow juice on colour and appearence of *kalakand*.**

Among the added levels of kinnow juice, the highest score for colour and appearance was *kalakand* having 15 parts of kinnow juice with faint orange colour and appeared fresh whereas *kalakand* obtained from 25 parts of kinnow juice gave dark shades with totally dull appearance which was not liked so many judges. The significant differences were found between treatments $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively. From the above results, it was found that treatment $T_3$ (15 parts of kinnow juice) was best among all other treatments.

The results obtained in the present research work are analogous with Wadewale (2010), Kumar & Singh (2015), they used mandarin orange juice and wood apple pulp respectively.

The result obtained from research work are analogous with Kumar and Singh (2017) of kalakand supplemented with wood apple pulp and they revealed that increase level of wood apple pulp the colour and appearance score increased from treatment $T_0$ to $T_4$ (7.30±0.03 8.30±0.06), respectively.

The result obtained from research work are analogous with Verma *et.al.*, (2018) of kalakand with addition of coconut milk and sapota pulp and they revealed that increase level of coconut milk and sapoata pulp the colour and appearance score increased from treatment $T_0$ to $T_3$ from 7.6 to 8.8 respectively.

The result obtained from research work are discord with Sawant (2006) of preparation of kalakand with sapota fruit pulp and reported that increase level of sapota pulp the colour and appearance score decreased from treatment $T_0$ (8.32), $C_1$ (7.82) and $C_2$ (7.21) respectively.

The result obtained from research work are discord with Dhanwade (2006) of preparation of kalakand with safflower milk and reported that increase level of safflower milk the colour and appearance score decreased from treatment $T_0$ (8.80), $T_1$ (7.80), $T_2$ (7.40) and $T_3$ (6.40) $T_4$ respectively.

### 4.1.2 Body and texture of kinnow juice *kalakand*

Body and texture of kinnow juice *kalakand* was determined under different treatment combination. Body and texture affect physical nature of *kalakand*. The average body and texture score for control *Kalakand* ($T_1$) and *Kalakand* prepared

from different level of kinnow juice viz. 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are depicted in Table 4.2 and graphically represented in Figure 4.1.2

**Table 4.2: Effect of various levels of kinnow juice on Body and texture of *kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 8.26 | 8.24 | 8.28 | 8.25 | **8.26$^{c}$** |
| **$T_2$** | 8.40 | 8.40 | 8.44 | 8.42 | **8.42$^{b}$** |
| **$T_3$** | 8.60 | 8.57 | 8.55 | 8.59 | **8.58$^{a}$** |
| **$T_4$** | 8.20 | 8.25 | 8.19 | 8.22 | **8.22$^{c}$** |
| **$T_5$** | 7.84 | 7.80 | 8.10 | 7.90 | **7.91$^{d}$** |
| **SE ± 0.081828** | | | | **CD at 5 %** | **0.246656** |

(The values with different small letters superscripts differ significantly at 5 per cent level of significance.)

It may be apparent from table 4.2 the body and texture score for various treatments ranged between 7.91 to 8.58. The score for treatment $T_3$ (8.58) was maximum followed by $T_2$ (8.42), $T_1$ (8.26), $T_4$ (8.22) and $T_5$ (7.91) respectively. The acceptable highest score was obtained for treatment $T_3$ (8.58) which has 15 parts of kinnow juice. The lowest score was obtained for treatment $T_5$ (7.91) which has 25 parts of kinnow juice and formed more granular texture in *kalakand* by increasing acidity. The results showed that the treatment $T_3$ (15 parts of kinnow juice) indicated that the alter significant body and texture, whereas increasing level of kinnow juice which affect body and texture of *kalakand* its form sticky body and big granular texture. This might due to the increase in moisture content and acidity in *kalakand* with addition of kinnow juice.

The result obtained from research work are analogous with Wadewale (2010) of *burfi* with addition of mandarin orange and they found that increase level of mandarin orange juice which formed sticky body and granular texture in product by increasing acidity and moisture content in *burfi*.

The result obtained from research work are analogous with Kumar and Singh (2017) of kalakand supplemented with wood apple pulp and they revealed that increase level of wood apple pulp the body and texture score increased from treatment $T_0$ to $T_4$ (7.90±0.04 to 8.40±0.05), respectively.

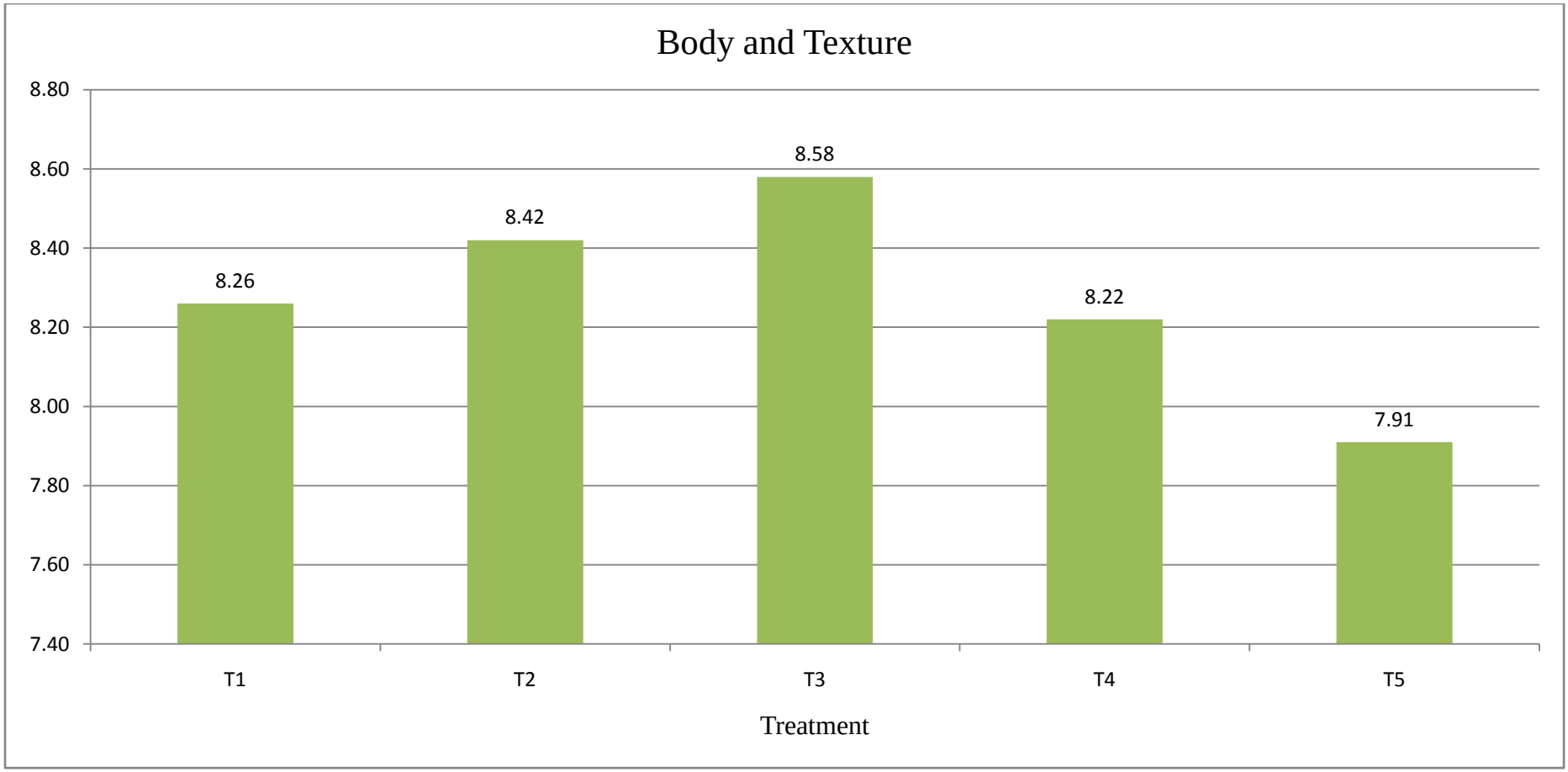


**Figure 4.1.2Effect of various levels of kinnow juice on body and texture of *kalakand*.**

The result obtained from research work are discord with Sawant (2006) of preparation of kalakand with sapota fruit pulp and reported that increase level of sapota pulp the body and texture score decreased from treatment $T_0$ (8.96), $C_1$ (8.38) and $C_2$ (8.24) respectively.

The result obtained from research work are discord with Dhanwade (2006) of preparation of kalakand with safflower milk and reported that increase level of safflower milk the body and texture score decreased from treatment $T_0$ (8.42), $T_1$ (7.80), $T_2$ (7.58) and $T_3$ (7.00) respectively.

The result obtained from research work are discord with Verma *et. al.,* (2018) of *kalakand* with addition of coconut milk and sapota pulp and they revealed that increase level of coconut milk and sapoata pulp the body and texture score decreased from treatment $T_0$ to $T_3$ from 8.7 to 7.2 respectively.

### 4.1.3 Flavour of kinnow juice *kalakand*

Flavour of *kalakand* was the sum of taste and aroma. Under different treatment combination kinnow juice *kalakand* was determined. The average flavour score for control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are depicted in Table 4.3 and graphically represented in Figure 4.1.3.

It is apparent from table 4.3 the flavour score for various treatments ranged between 7.91 to 8.49. The score for treatment $T_3$ (8.49) was maximum score followed by $T_2$ (8.25), $T_4$ (8.19), $T_1$ (8.17) and $T_5$ (7.91). The acceptable maximum score was found for treatment $T_3$ (8.49) which has 15 parts of kinnow juice. The lowest score was recorded in treatment $T_5$ (7.91) which contained 25 parts of kinnow juice having maximum acidity content. This showed that as the level of kinnow juice increases, the flavour score of *kalakand* also increases to treatment $T_3$ (15 parts of kinnow juice), but in treatment $T_4$ (20 parts of kinnow juice) and $T_5$ (25 parts of kinnow juice) the flavour score was decreases. It showed that the level of kinnow juice at treatment $T_3$ are the best as compare to rest of the treatments.

**Table 4.3: Effect of various levels of kinnow juice on flavour of *kalakand.***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| $T_1$ | 8.12 | 8.17 | 8.17 | 8.21 | **8.17[b]** |
| $T_2$ | 8.19 | 8.24 | 8.30 | 8.26 | **8.25[b]** |
| $T_3$ | 8.49 | 8.47 | 8.48 | 8.50 | **8.49[a]** |
| $T_4$ | 8.06 | 8.11 | 8.17 | 8.40 | **8.19[b]** |
| $T_5$ | 7.95 | 7.89 | 7.91 | 7.88 | **7.91[c]** |
| **SE ± 0.036839** | | | | **CD at 5 % 0.111044** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

The result obtained from research work are agreement with Wadewale (2010) of *burfi* with addition of mandarin orange juice and they found that increase level of mandarin orange juice at certain level increase flavour score.

The result obtained from research work are analogous with Kumar & Singh (2017) of *kalakand* with addition of wood apple pulp and they found that flavour score range between 7.20 to 8.60.

The result obtained from research work are discord with Sawant (2006) of *kalakand* due to addition of sapota pulp and found that the increase in level of sapota pulp decreases flavour score.

The result obtained from research work are discord with Dhanwade *et.al*., (2006) of *kalakand* due to addition of safflower milk and found that the increase in level of safflower milk decrease flavour score from treatment $T_0$ to $T_3$ (8.75 to 6.40).

### 4.1.4 Overall acceptability of kinnow juice *kalakand*

Overall acceptability of *kalakand* under different treatment combination of kinnow juice *kalakand* was determined. The average Overall acceptability score for control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are depicted in Table 4.4 and graphically represented in Figure 4.1.4

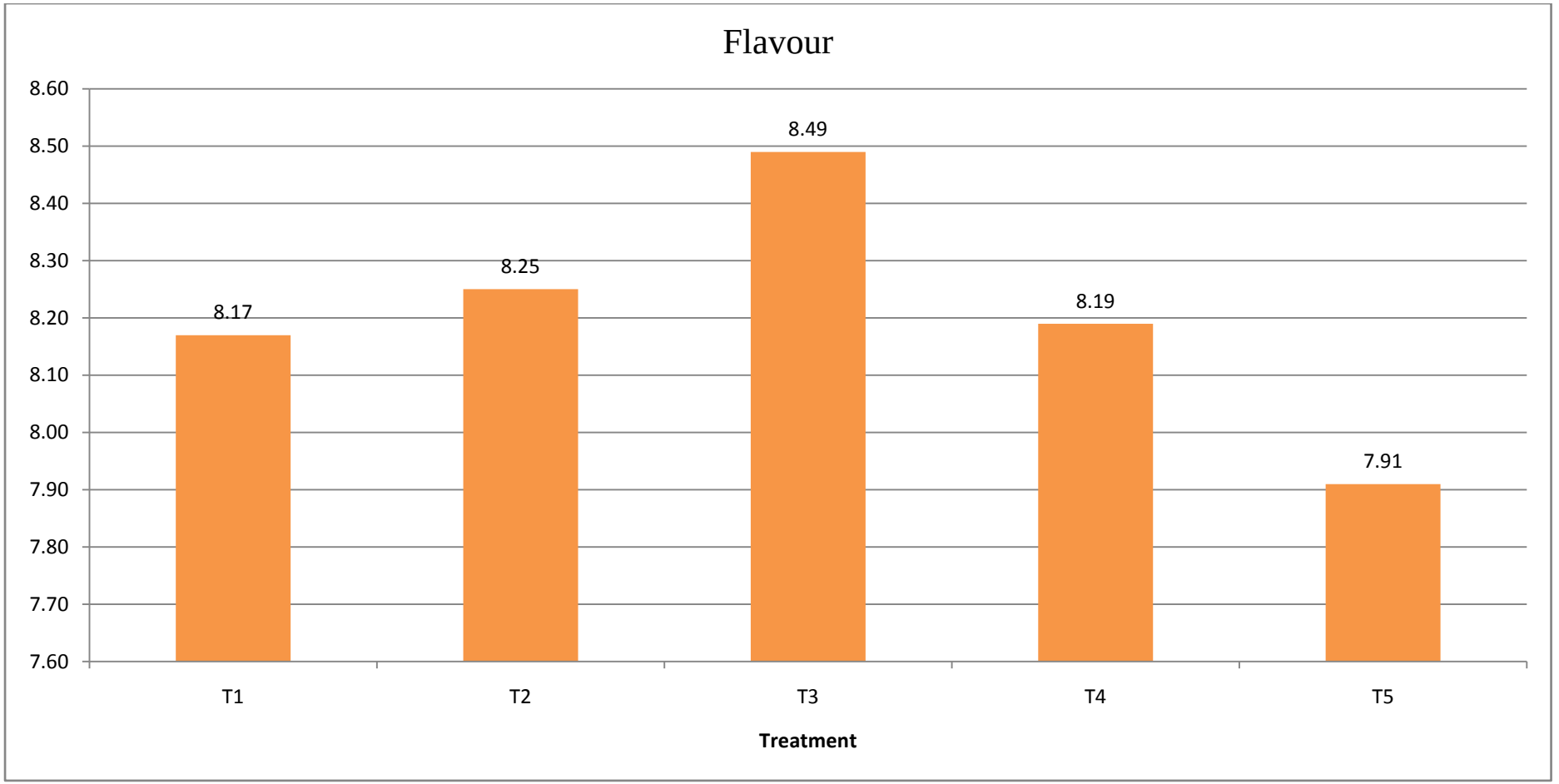


**Figure 4.1.3Effect of various levels of kinnow juice on flavour of *kalakand*.**

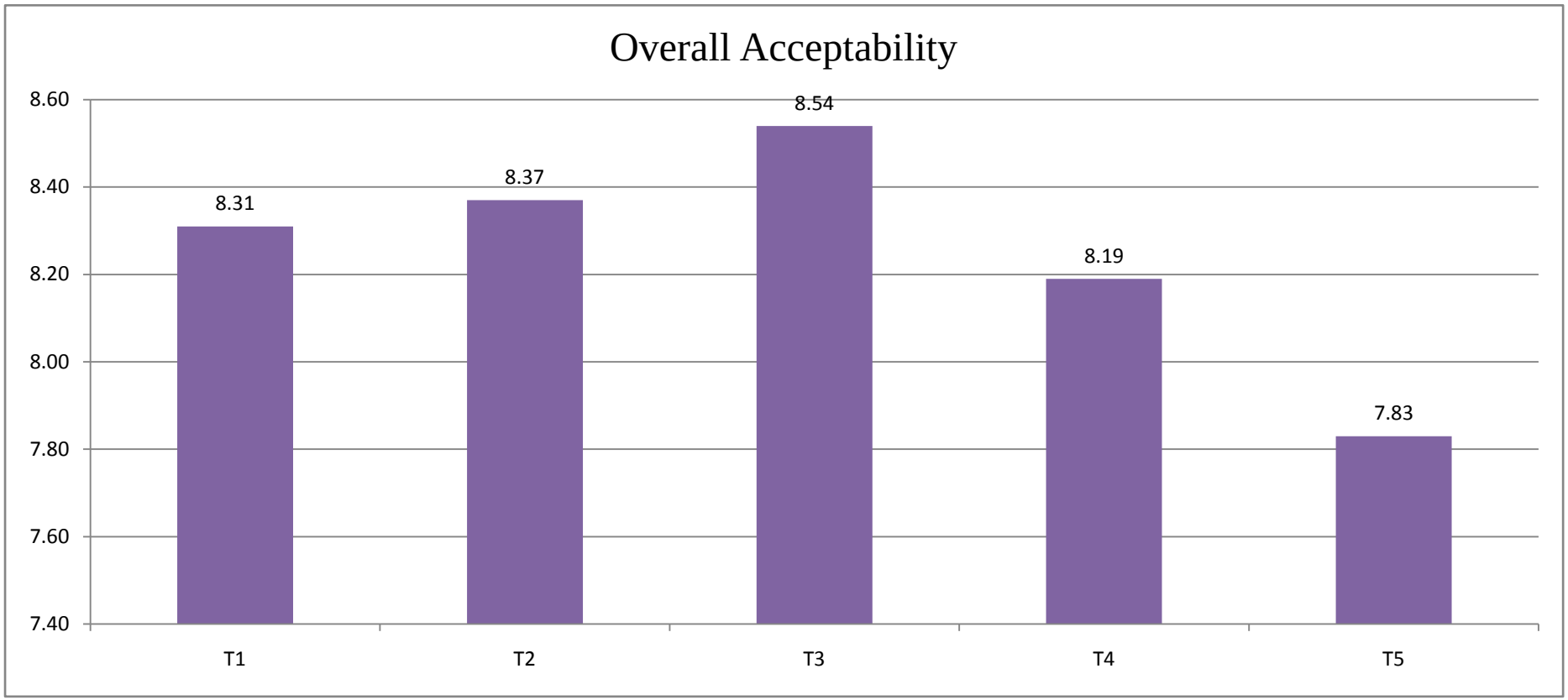


**Figure 4.1.4Effect of various levels of kinnow juice on overall acceptability of *kalakand*.**

**Table 4.4: Effect of various levels of kinnow juice on Overall acceptability of *kalakand.***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| $T_1$ | 8.32 | 8.35 | 8.29 | 8.27 | **8.31[c]** |
| $T_2$ | 8.39 | 8.41 | 8.35 | 8.34 | **8.37[b]** |
| $T_3$ | 8.55 | 8.58 | 8.52 | 8.50 | **8.54[a]** |
| $T_4$ | 8.22 | 8.14 | 8.18 | 8.20 | **8.19[d]** |
| $T_5$ | 7.84 | 7.81 | 7.83 | 7.82 | **7.83[e]** |
| **SE ± 0.015612** | | | | **CD at 5 % 0.047061** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

It is apparent from table 4.4 the Overall acceptability score for various treatments ranged between 7.83 to 8.54. The score for treatment $T_3$ (8.54) was maximum followed by $T_2$ (8.37), $T_1$ (8.31), $T_4$ (8.19) and $T_5$ (7.83). The acceptable maximum score was found for treatment $T_3$ (8.54) which has 15 parts of kinnow juice. The lowest score was recorded in treatment $T_5$ (7.83) which contain 25 parts of kinnow juice. Since the score of all the samples were above 5.5, it was defined that kinnow juice which prepared under all treatments were acceptable. Total sensory score of kinnow juice *kalakand* differed significantly due to the different levels of kinnow juice added. Among all the samples, $T_3$ sample has greasier with grainy texture, good flavour with no deleterious effect on colour and appearance. It was having significant natural flavour of kinnow juice and smooth to granular texture. Therefore, it was liked by all judges among all the treatments including control sample.

The result obtained from research work are analogous with Wadewale (2010) for *burfi*, Kumar & Singh (2017) for *kalakand*, they are used as mandarin orange juice and wood apple pulp.

The result obtained from research work are analogous with Kumar & Singh (2017) of *kalakand* with addition of wood apple pulp and he found that overall acceptability score range between 7.40±0.05 to 8.10±0.06 from treatment $T_0$ to $T_3$ respectively.

Verma (2018) narrated the overall acceptability score of *kalakand* blended with coconut milk and sapota pulp. In that score was 7.5, 8.0, 8.4 and 8.9 which however described that overall acceptability score increased first then it goes on decreasing trend.

## 4.2 Proximate chemical analysis of kinnow juice *kalakand*

*Kalakand* sample prepared under each treatment were analysed for moisture, fat, protein, total solids, ash, acidity, pH and carbohydrate. The results are depicted in following tables.

### 4.2.1 Moisture content of kinnow juice *kalakand*

Moisture content in kinnow juice *kalakand* was determined under different treatment combination. Moisture affect various biochemical and microbiological activities which directly influences the shelf life of the *kalakand*. The results obtained to moisture content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.5 and graphically represented in Figure 4.2.1.

**Table 4.5: Effect of various levels of kinnow juice on per cent moisture content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 17.30 | 17.00 | 16.80 | 17.10 | **17.05$^{d}$** |
| **$T_2$** | 17.00 | 17.50 | 17.80 | 17.30 | **17.40$^{d}$** |
| **$T_3$** | 19.00 | 19.25 | 19.55 | 19.40 | **19.30$^{c}$** |
| **$T_4$** | 20.60 | 21.00 | 21.30 | 20.10 | **20.75$^{b}$** |
| **$T_5$** | 22.00 | 22.60 | 22.90 | 23.00 | **22.63$^{a}$** |
| **SE ± 0.184955** | | | | **CD at 5 % 0.557514** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

It is seen from table 4.5 that the moisture content of *kalakand* are lowest for treatment $T_1$ and it was increased gradually upto $T_5$. The moisture content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 17.05, 17.40, 19.30, 20.75 and 22.63 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the moisture

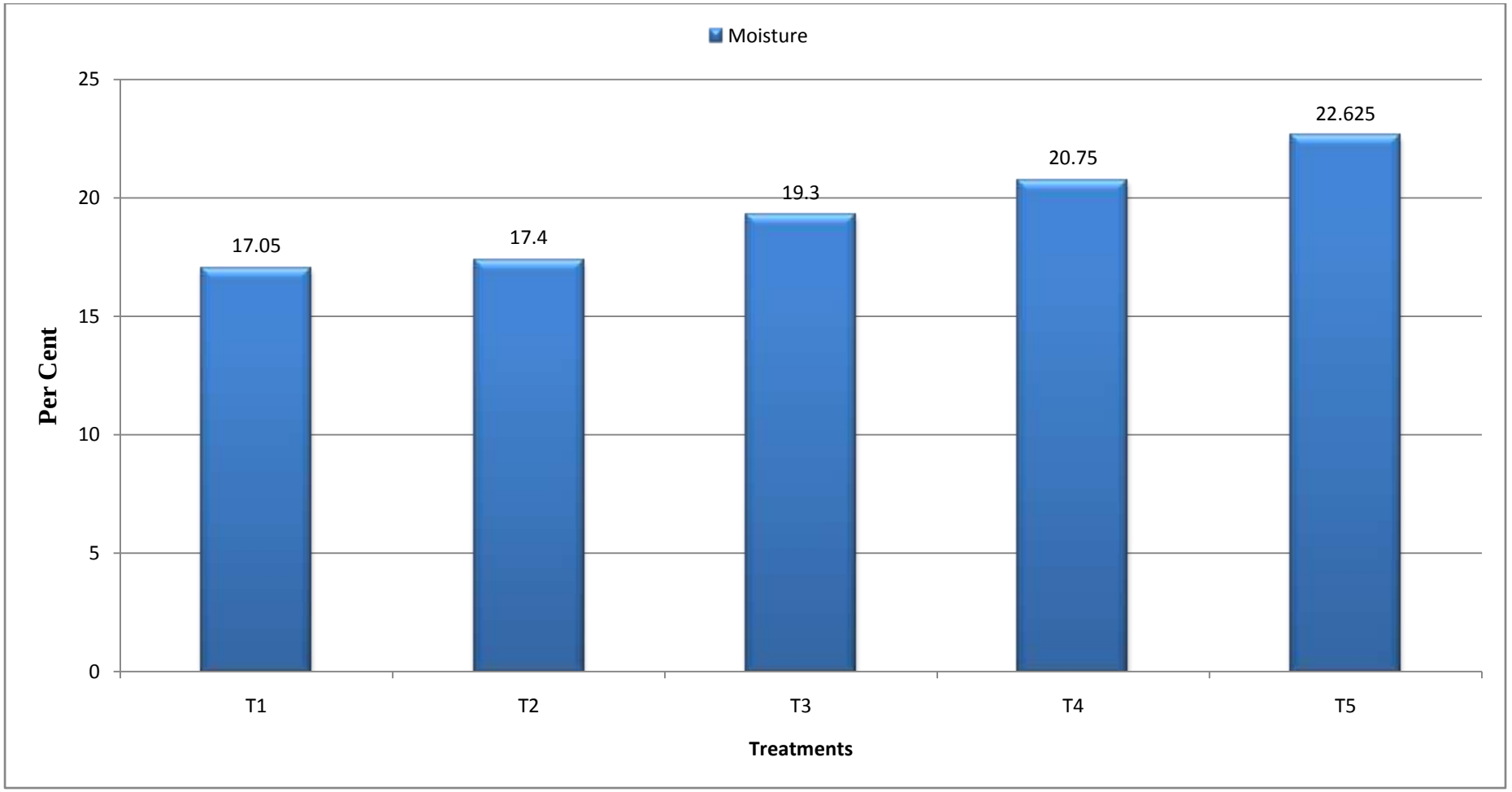


**Figure 4.2.1 Effect of various levels of kinnow juice on per cent moisture content of *kalakand***

content 19.30 per cent. The moisture content of *kalakand* increase in treatment $T_3$ (19.30 per cent) as compare to $T_2$ (17.40 per cent) and $T_1$ (17.05 per cent), whereas increases in treatment $T_4$ (20.75 per cent) and $T_5$ (22.63 per cent). As kinnow juice level increased, moisture content in *kalakand* increased and vice-versa.

The results obtained in the present research work are in analogous with Wadewale (2010) and Thikare *et.al*., (2020), they used mandarin orange juice and strawberry pulp respectively in their study.

The results obtained in the present research work are in discord with Thakur (2017), they used custard apple and found that the moisture content in *kalakand* decrease with increase in custard apple pulp.

### 4.2.2 Fat content of kinnow juice *kalakand*

Fat content in kinnow juice *kalakand* under different treatment combination was determined. The results obtained to fat content of control *kalakand* ($T_1$) and *kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in Table 4.6 and graphically represented in Figure 4.2.2.

**Table 4.6: Effect of various levels of Kinnow juice on per cent fat content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 21.00 | 21.10 | 22.00 | 21.20 | **21.33$^{a}$** |
| **$T_2$** | 20.50 | 20.60 | 21.60 | 20.90 | **20.90$^{a}$** |
| **$T_3$** | 19.75 | 20.30 | 20.60 | 19.90 | **20.14$^{ab}$** |
| **$T_4$** | 17.75 | 19.00 | 19.60 | 19.20 | **18.89$^{bc}$** |
| **$T_5$** | 14.50 | 18.33 | 18.20 | 18.90 | **17.48$^{c}$** |
| **SE ± 0.514197** | | | | **CD at 5 % 1.548** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

It was observed from table 4.6 that the fat content of *kalakand* was significantly affected due to addition of kinnow juice. The average fat content was significantly highest for treatment $T_1$ (21.33 per cent) and it decreased gradually to $T_5$ (17.48 per cent). The fat content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 21.33, 20.90,

20.14, 18.89 and 17.48 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the fat content 20.14 per cent. The fat content of *kalakand* decrease in treatment $T_3$ (20.14 per cent) as compare to $T_2$ (20.90 per cent) and $T_1$ (21.33 per cent), whereas decreases in treatment $T_4$ (18.89 per cent) and $T_5$ (17.48 per cent). As kinnow juice level increased, fat content in *kalakand* decreased and vice-versa.

The results obtained are in analogous with Wadewale (2010) of *burfi* due to addition of mandarin orange juice, David (2015) of *kalakand* due to use of fat replacer maltodextrin, Kumar & Singh (2017) of *kalakand* due to addition of wood apple pulp, Thakur (2017) of *kalakand* blended with custard apple and Verma (2018) of *kalakand* blended with coconut milk and sapota pulp and Thikare *et al*., (2020) *kalakand* blended with strawberry pulp.

### 4.2.3 Protein content of kinnow juice *kalakand*

Protein content in kinnow juice *kalakand* was determined under different treatment combination. The results obtained of protein content in control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.7 and graphically represented in figure 4.2.3.

**Table 4.7: Effect of various levels of Kinnow juice on per cent protein content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 15.00 | 15.60 | 15.20 | 15.40 | **15.30$^a$** |
| **$T_2$** | 14.82 | 15.02 | 14.86 | 15.05 | **14.94$^b$** |
| **$T_3$** | 14.11 | 14.35 | 14.09 | 14.32 | **14.22$^c$** |
| **$T_4$** | 13.39 | 13.65 | 13.39 | 13.60 | **13.51$^d$** |
| **$T_5$** | 12.59 | 13.00 | 12.76 | 13.00 | **12.84$^e$** |
| **SE ± 0.088666** | | | | **CD at 5 % = 0.267268** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

It is apparent from table 4.7 that the protein content of *kalakand* was significantly affected due to addition of kinnow juice. The average protein content was significantly highest for treatment $T_1$ (15.30 per cent) and it decreased gradually

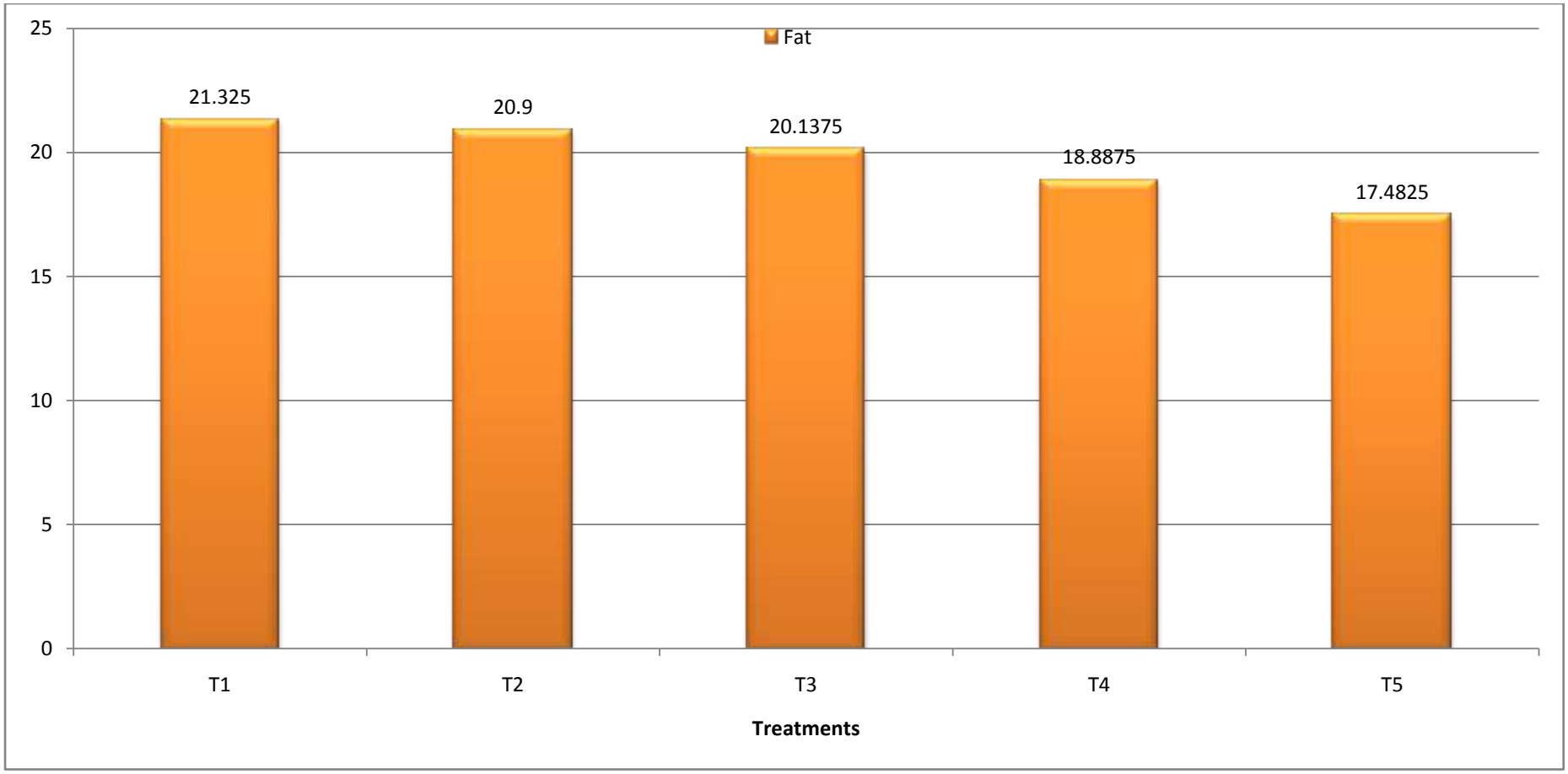


**Figure 4.2.2Effect of various levels of kinnow juice on per cent fat content of *kalakand*.**

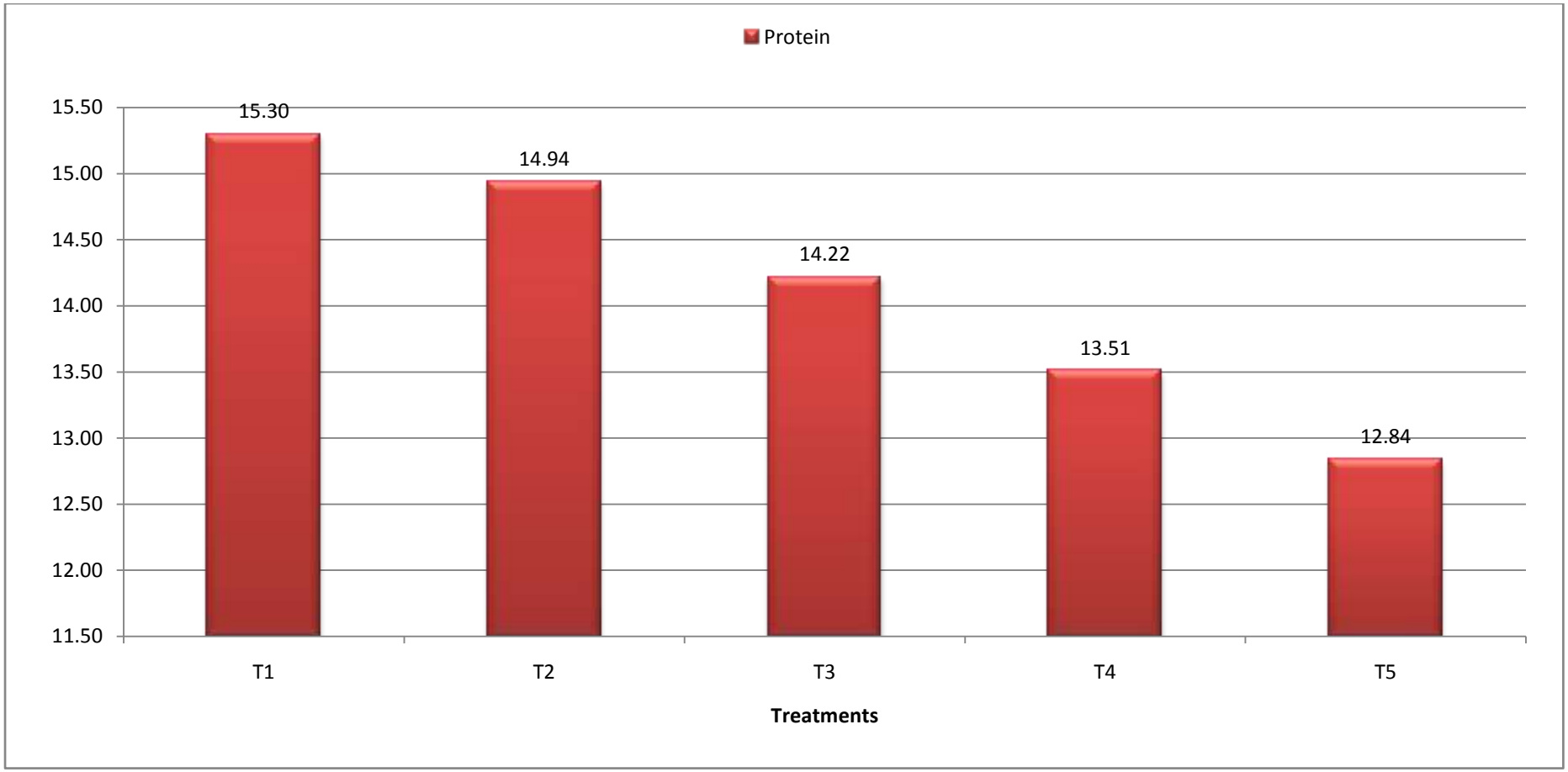


**Figure 4.2.3 Effect of various levels of kinnow juice on per cent protein content of *kalakand*.**

to treatment $T_5$ (12.84 per cent). The protein content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 15.30, 14.94, 14.22, 13.51 and 12.84 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the protein content 14.22 per cent. The protein content of *kalakand* decrease in $T_3$ (14.22 per cent) as compare to $T_2$ (14.94 per cent) and $T_1$ (15.30 per cent), whereas decrease in $T_4$ (13.51 per cent) and $T_5$ (12.84 per cent). As kinnow juice level increased, protein content in *kalakand* decreased and vice-versa.

The results obtained in the present research work are in analogous with Wadewale (2010), Bhutkar *et al*., (2015), Thakur *et al*., (2017) and Thikare *et al*., (2020), they used mandarin orange juice, ash gourd pulp, custard apple and strawberry pulp respectively in their study.

### 4.2.4 Total solids content of kinnow juice *kalakand*

Total solids content in kinnow juice *kalakand* was determined under different treatment combination. The results obtained to total solids content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.8 and graphically represented in Figure 4.2.4.

**Table 4.8: Effect of various levels of Kinnow juice on per cent total solids content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 82.70 | 83.00 | 83.20 | 82.90 | **82.95[a]** |
| **$T_2$** | 83.00 | 82.50 | 82.20 | 82.70 | **82.60[a]** |
| **$T_3$** | 81.00 | 80.75 | 80.45 | 80.60 | **80.70[b]** |
| **$T_4$** | 79.40 | 79.00 | 78.70 | 79.90 | **79.25[c]** |
| **$T_5$** | 78.00 | 77.40 | 77.10 | 77.00 | **77.38[d]** |
| **SE ± 0.184955** | | | | **CD at 5 % = 0.557514** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

It is apparent from table 4.8 that the total solids content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum total solids content in treatment $T_1$ (82.95 per cent), whereas minimum in treatment $T_5$ (77.38 per

cent). The total solids content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 82.95, 82.60, 80.70, 79.25 and 77.38 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the total solids content 80.70 per cent. Total solids content of *kalakand* decreased in $T_3$ (80.70 per cent) as compare to treatment $T_2$ (82.60 per cent) and $T_1$ (82.95 per cent). It is indicated that as the kinnow juice level increased, total solids content in *kalakand* was decreased. This might be due to less of fat and protein content in kinnow juice.

The results obtained in analogous with Wadewale (2010) of *burfi* due to addition of mandarin orange juice, Kumar & Singh (2017) of *kalakand* due to addition of wood apple pulp, Verma *et al*., (2018) of *kalakand* blended with coconut milk and sapota pulp and Thikare *et al*., (2020) of *kalakand* blended with strawberry pulp.

The results obtained in discord with those reported by Thakur *et al*., (2017) of *kalakand* due to addition of custard apple pulp.

### 4.2.5 Total carbohydrate content of kinnow juice *kalakand*

Total carbohydrate content in kinnow juice *kalakand* was determined under different treatment combination. The results obtained for total carbohydrate content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in Table 4.9 and graphically represented in Figure 4.2.5.

**Table 4.9: Effect of various levels of Kinnow juice on per cent total carbohydrate content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 40.14 | 41.00 | 42.66 | 42.88 | **41.67$^{d}$** |
| **$T_2$** | 43.40 | 42.90 | 42.70 | 41.80 | **42.70$^{d}$** |
| **$T_3$** | 43.00 | 43.60 | 43.15 | 43.35 | **43.28$^{c}$** |
| **$T_4$** | 43.64 | 43.50 | 44.05 | 43.95 | **43.79$^{b}$** |
| **$T_5$** | 44.25 | 44.00 | 44.40 | 43.90 | **44.14$^{a}$** |
| **SE ± 0.7** | | | | **CD at 5 % = 1.039328** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

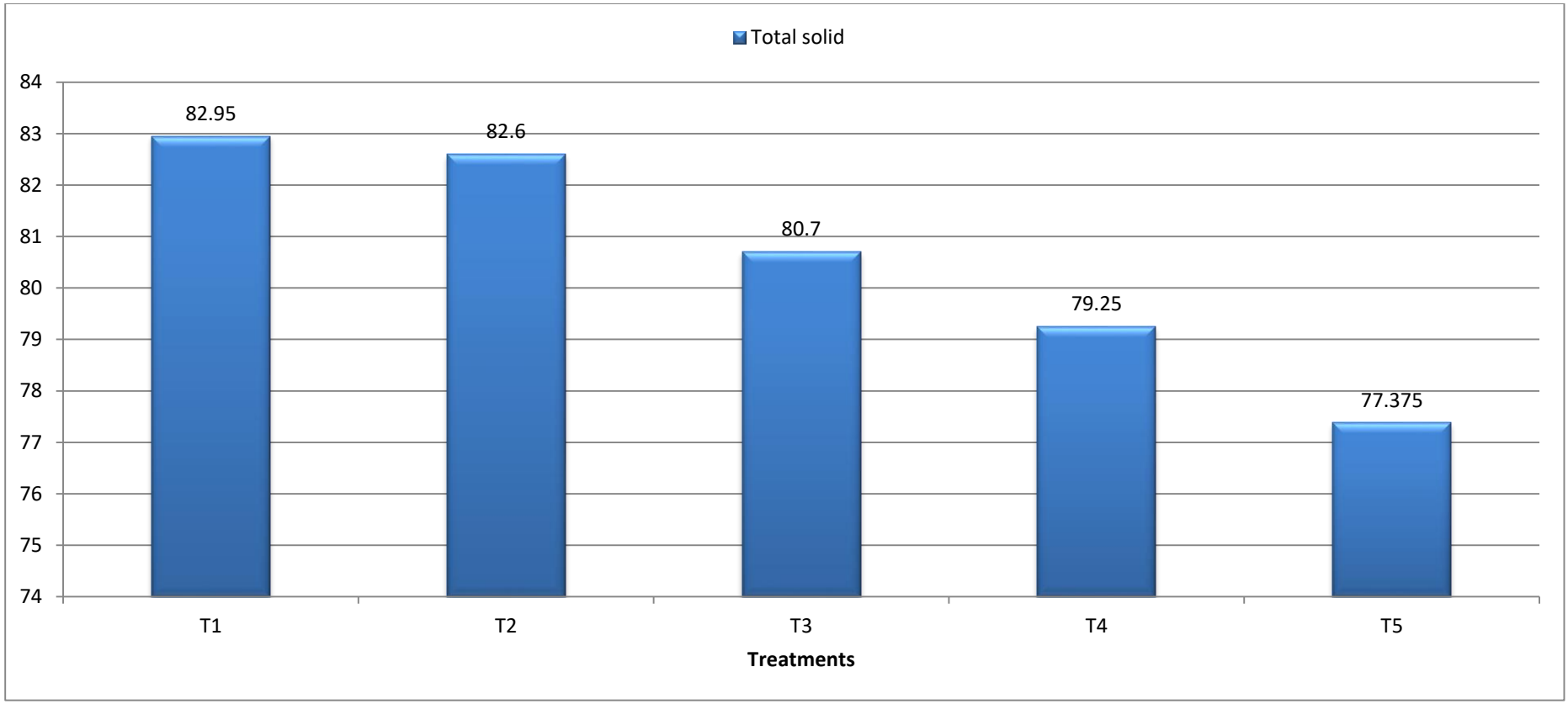


**Figure 4.2.4 Effect of various levels of kinnow juice on per cent total solids content of *kalakand*.**

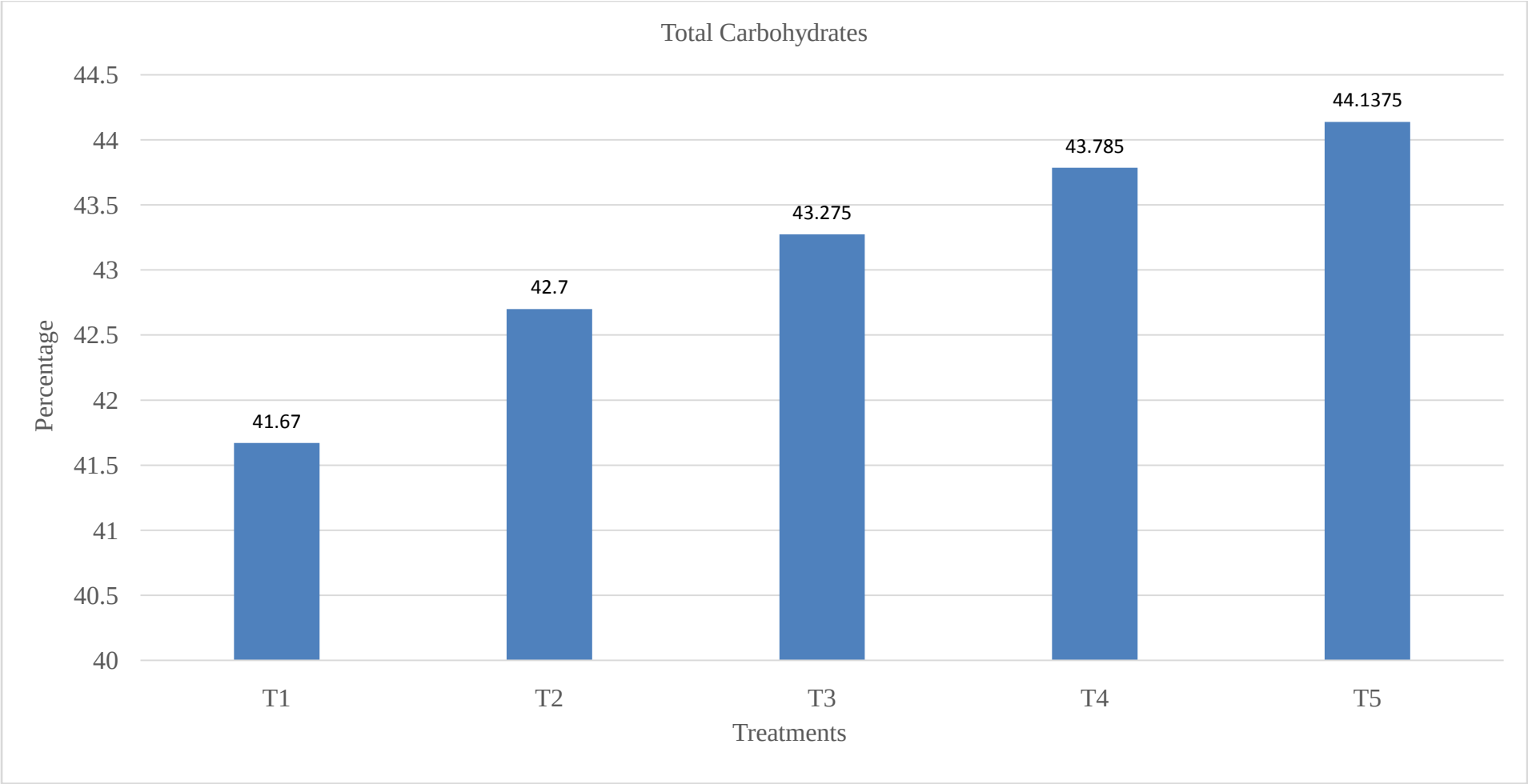


**Figure 4.2.5Effect of various levels of kinnow juice on per cent total carbohydrate content of *kalakand*.**

It is apparent from table 4.9 that the total carbohydrate content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum total carbohydrate content in treatment $T_5$ (44.14 per cent), whereas minimum in treatment $T_1$ (41.67 per cent). The total carbohydrate content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 41.67, 42.70, 43.28, 43.79 and 44.14 per cent respectively.

The treatment $T_3$ (15 parts of kinnow juice) recorded the total carbohydrate content 43.28 per cent. The total carbohydrate content of *kalakand* increase in $T_3$ (43.28 per cent) as compare to treatment $T_1$ and $T_2$. It is indicated that as the kinnow juice level increased, total carbohydrate content in *kalakand* increased.

The results obtained in discord with those reported by Kumar & Singh (2017) of *kalakand* due to addition of wood apple pulp, Thikare *et al*., (2020) of *kalakand* due to addition of strawberry pulp.

The result obtained in analogous with those reported by Sawant *et al*., (2006) of *kalakand* due to addition of sapota fruit pulp.

### 4.2.6 Ash content of kinnow juice *kalakand*

Ash content in kinnow juice *kalakand* under different treatment combination was determined. The results obtained to ash content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.10 and graphically represented in Figure 4.2.6

It is apparent from table 4.10 that the ash content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum ash content in treatment $T_1$ (3.10 per cent), whereas minimum in treatment $T_5$ (2.43 per cent). The ash content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 3.10, 2.85, 2.80, 2.55 and 2.43 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the ash content 2.80 per cent. The ash content of *kalakand* decrease in $T_3$ (2.80 per cent) as compare to $T_2$ (2.85 per cent) and $T_1$ (3.10 per cent) also decreased in treatment $T_4$ (2.55 per cent) and $T_5$ (2.43 per cent). It is indicated that as the kinnow juice level increased, ash content in *kalakand* was decreased.

**Table 4.10: Effect of various levels of kinnow juice on per cent Ash content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| $T_1$ | 3.00 | 3.20 | 3.00 | 3.20 | **3.10**[a] |
| $T_2$ | 2.60 | 3.00 | 2.80 | 3.00 | **2.85**[b] |
| $T_3$ | 2.80 | 2.80 | 2.80 | 2.80 | **2.80**[b] |
| $T_4$ | 2.60 | 2.70 | 2.40 | 2.50 | **2.55**[c] |
| $T_5$ | 2.60 | 2.60 | 2.20 | 2.30 | **2.43**[c] |
| **SE ± 0.073881** | | | | **CD at 5 % = 0.2227** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

The results obtained in analogous with Wadewale (2010) of *burfi* due to addition of mandarin orange juice and Verma *et. al*. (2018) of *kalakand* due to addition of coconut milk and sapota pulp.

The result obtained in discord with Thakur *et al*., (2017) of *kalakand* due to addition of custard apple pulp, Thikare *et al*., (2020) of *kalakand* due to addition of strawberry pulp.

### 4.2.7 Acidity content of kinnow juice *kalakand*

Acidity content in kinnow juice *kalakand* was determined under different treatment combination. The results obtained to acidity content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.11 and graphically represented in figure 4.2.7.

It is apparent from table 4.11 that the acidity content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum acidity content in treatment $T_5$ (0.75 per cent), while minimum in treatment $T_1$ (0.33 per cent). The acidity content of treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 0.33, 0.38, 0.52, 0.59 and 0.75 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the acidity content 0.52 per cent. The acidity content of *kalakand* increased in $T_3$ (0.52 per cent) as compare to $T_2$ (0.35) and T1 (0.33 per cent), whereas increased in treatment $T_4$

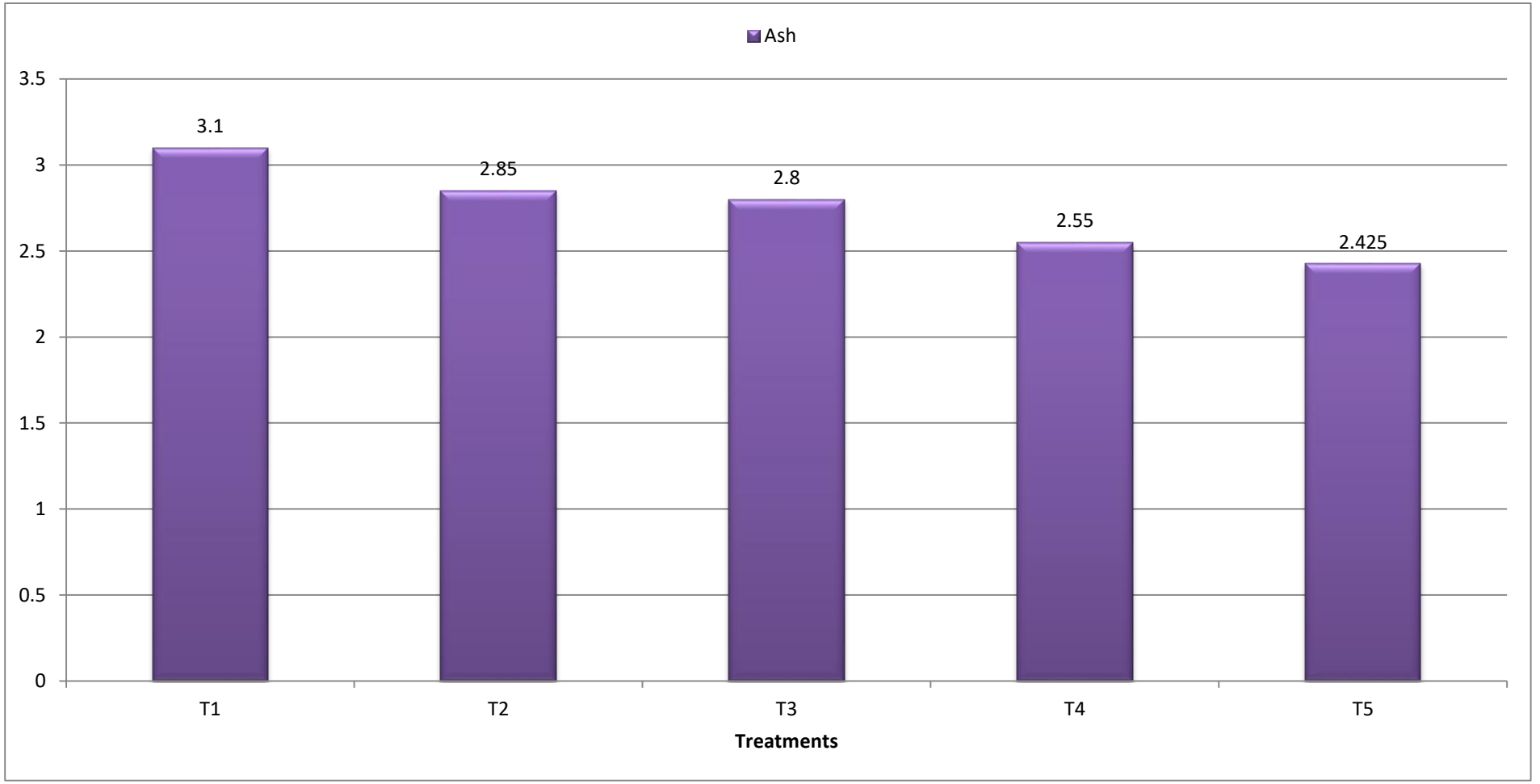


**Figure 4.2.6 Effect of various levels of kinnow juice on per cent ash content of *kalakand***

(0.59 per cent) and $T_5$ (0.75 per cent). It is indicated that as the kinnow juice level increased, acidity content in *kalakand* was increased.

**Table 4.11: Effect of various levels of Kinnow juice on per cent acidity content of *Kalakand***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 0.32 | 0.34 | 0.32 | 0.34 | **0.33[a]** |
| **$T_2$** | 0.38 | 0.40 | 0.36 | 0.38 | **0.38[b]** |
| **$T_3$** | 0.54 | 0.52 | 0.50 | 0.53 | **0.52[c]** |
| **$T_4$** | 0.58 | 0.61 | 0.58 | 0.61 | **0.59[d]** |
| **$T_5$** | 0.72 | 0.76 | 0.77 | 0.74 | **0.75[e]** |
| **SE ± 0.008819** | | | | **CD at 5 % = 0.026585** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

Wadewale (2010) reported that the acidity content in mandarin orange *burfi* are range from 0.41 to 0.46 per cent. He reported that the mandarin orange juice level increased, acidity content in *burfi was* increased.

Thikare *et al*., (2020) reported that the acidity content in range of 0.55 to 0.75 per cent in various combination of strawberry *kalakand*. He reported that the strawberry pulp level increased, acidity content in *kalakand* was increased.

### 4.2.8 pH content of kinnow juice *kalakand*

pH content in kinnow juice *kalakand* under different treatment combination was determined. The results obtained to pH content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in table 4.12 and graphically represented in Figure 4.2.8.

It is revealed from table 4.12 that the pH content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum pH content for treatment $T_1$ (6.74) while minimum pH content in treatment $T_5$ (6.05). The pH content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 6.74, 6.59, 6.40, 6.21 and 6.05, respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the pH content 6.40. The pH content

of *kalakand* decrease in $T_3$ (6.40) as compare to $T_2$ (6.59) and $T_1$ (6.74) also decreased in $T_4$ (6.21) and $T_5$ (6.05). It is indicated that as the kinnow juice level increased, pH content in *kalakand* decreased. This might be due to high acidity content in kinnow juice as compare to buffalo milk *kalakand*.

**Table 4.12: Effect of various levels of Kinnow juice on pH content of *kalakand.***

| Treatments | Replications | | | | Mean score |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **$T_1$** | 6.70 | 6.65 | 6.72 | 6.89 | **6.74[a]** |
| **$T_2$** | 6.64 | 6.58 | 6.60 | 6.55 | **6.59[b]** |
| **$T_3$** | 6.43 | 6.38 | 6.43 | 6.35 | **6.40[c]** |
| **$T_4$** | 6.20 | 6.21 | 6.26 | 6.15 | **6.21[d]** |
| **$T_5$** | 6.04 | 6.06 | 6.10 | 6.01 | **6.05[e]** |
| **SE ± 0.029418** | | | | **CD at 5 % = 0.088675** | |
| (The values with different small letters superscripts differ significantly at 5 per cent level of significance.) | | | | | |

The results obtained in analogous with those reported by Wadewale (2010) of *burfi* due to the addition of mandarin orange juice and found that decreases the pH in *burfi* with increase in mandarin orange juice.

The results obtained in analogous with those reported by Thikare *et al*., (2020) of *kalakand* due to the addition of strawberry pulp and found that decreases the pH in *kalakand* with increase in strawberry pulp.

### 4.2.9 Mean chemical composition of *Kalakand*

The mean chemical composition content in kinnow juice *kalakand* under different treatment combination was determined. The results obtained to mean chemical composition of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of Kinnow juice *viz.* 10, 15, 20 and 25 per cent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in Table 4.13 and graphically represented in Figure 4.2.9.

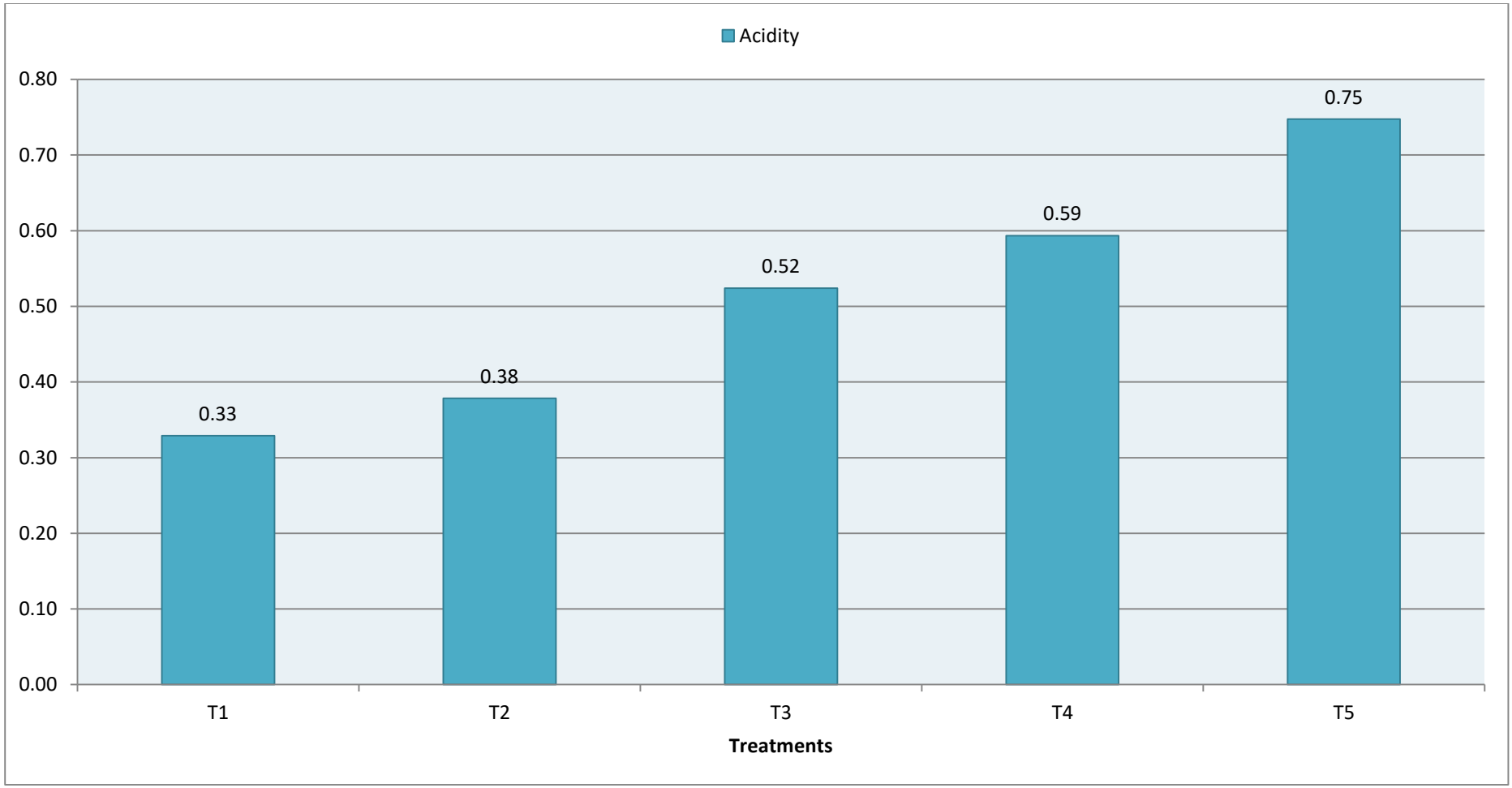


**Figure 4.2.7 Effect of various levels of kinnow juice on per cent acidity content of *kalakand.***

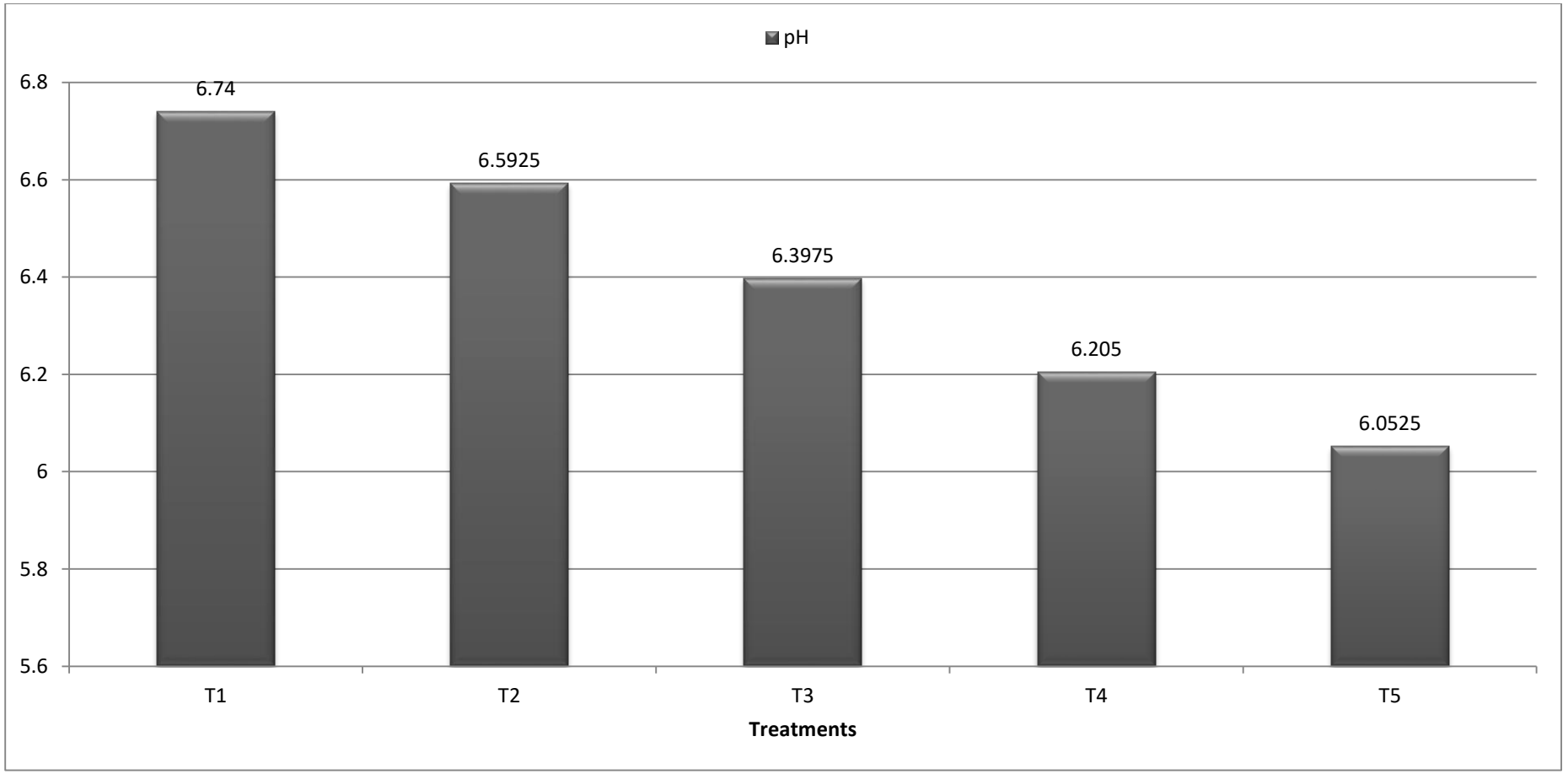


**Figure 4.2.8 Effect of various levels of kinnow juice on pH content of *kalakand*.**

**Table 4.13: Per cent mean chemical composition of kinnow juice *kalakand***

| Constituents | Treatments | | | | |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| **Moisture** | 17.05 | 17.40 | 19.30 | 20.75 | 22.63 |
| **Fat** | 21.33 | 20.90 | 20.14 | 18.89 | 17.48 |
| **Protein** | 15.30 | 14.94 | 14.22 | 13.51 | 12.84 |
| **Total solids** | 82.95 | 82.60 | 80.70 | 79.25 | 77.38 |
| **Total carbohydrate** | 41.67 | 42.70 | 43.28 | 43.79 | 44.14 |
| **Ash** | 3.10 | 2.85 | 2.80 | 2.55 | 2.43 |
| **Acidity** | 0.33 | 0.38 | 0.52 | 0.59 | 0.75 |
| **pH** | 6.74 | 6.59 | 6.40 | 6.21 | 6.05 |

## 4.3 Shelf life of *kalakand* at refrigerator temperature

Storage study was conducted and arrangement to know the shelf life of product at refrigerated (7±2ºC) temperature. The sample was evaluated for microbiological changes at 6 days interval up to 12 days at refrigerated temperature. The control and treated sample stored at refrigerator were analysed standard plate count, yeast and mould count and coliform count.

### 4.3.1 Standard plate count in *Kalakand* with addition of various levels of kinnow juice.

The results related to standard plate count (SPC) content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 percent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in Table 4.14 and graphically represented in Figure 4.3.1.

**Table 4.14: Standard plate count of *kalakand* with addition of various levels of kinnow juice**

| Days / Treatment | Standard plate count (SPC) ($\times 10^3$ cfu/g) | | |
|---|---|---|---|
| | $0^{th}$ day | $6^{th}$ day | $12^{th}$ day |
| $T_1$ | 15.10 | 6.8 | 2.4 |
| $T_2$ | 15.90 | 7.5 | 3.5 |
| $T_3$ | 16.30 | 8.4 | 4.9 |
| $T_4$ | 16.90 | 8.7 | 6.4 |
| $T_5$ | 17.50 | 9.1 | 8.0 |

It is apparent from table 4.13 that the SPC content of *kalakand* are significantly affected due to addition of kinnow juice. The control sample $T_1$ had significantly minimum SPC counts ($15.10\times10^3$) over the rest of sample during storage. The treatment $T_2$ ($15.90\times10^3$), $T_3$ ($16.30\times10^3$), $T_4$ ($16.90\times10^3$) and $T_5$ ($17.50\times10^3$) on 0 day sample. The SPC count of $0^{th}$ days range from 15.10 to 17.50 $\times 10^3$cfu/g for treatment $T_1$ to $T_5$. The sample $T_5$ had significantly higher SPC count probably due to moisture content as well as acidic pH of the product. On $6^{th}$ days range from 6.8 to 9.1 $\times 10^3$cfu/g and on $12^{th}$ days range from 2.4 to 8.0 for treatment $T_1$ to $T_5$. The sample $T_5$ had significantly maximum SPC count on fresh sample, $6^{th}$ days and $12^{th}$ days due to the moisture content as well as acidity of product. On storage period of $1^{st}$ and $12^{th}$ days SPC counts increase from treatment $T_1$ to $T_5$. The research work show that the level of kinnow juice increase with increase in SPC count of *kalakand*. The SPC in *kalakand* sample decreased as storage period progressed up to 12 days.

The results obtained in analogous with those reported by Jadhav *et al*., (2014) of *lassi* with addition of orange juice and they found that the SPC in orange juice *kalakand* sample decreased as storage period progressed up to 7 days.

### 4.3.2 Yeast and mould count in *Kalakand* with addition of various levels of kinnow juice.

The results related to yeast and mould count (YMC) content of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 percent ($T_2$, $T_3$, $T_4$ and $T_5$) are presented in Table 4.15 and graphically represented in Figure 4.3.2

**Table 4.15: Yeast and mould count of *Kalakand* with addition of various levels of kinnow juice**

| Days / Treatment | Yeast and Mould count (YMC) ($\times10^3$ cfu/g) | | |
|---|---|---|---|
| | $0^{th}$ day | $6^{th}$ day | $12^{th}$ day |
| **$T_1$** | 1.45 | 1.8 | 1.75 |
| **$T_2$** | 0.95 | 1.1 | 1.25 |
| **$T_3$** | 0.75 | 0.9 | 1.05 |
| **$T_4$** | 0.55 | 0.7 | 0.85 |
| **$T_5$** | 0.45 | 0.5 | 0.65 |

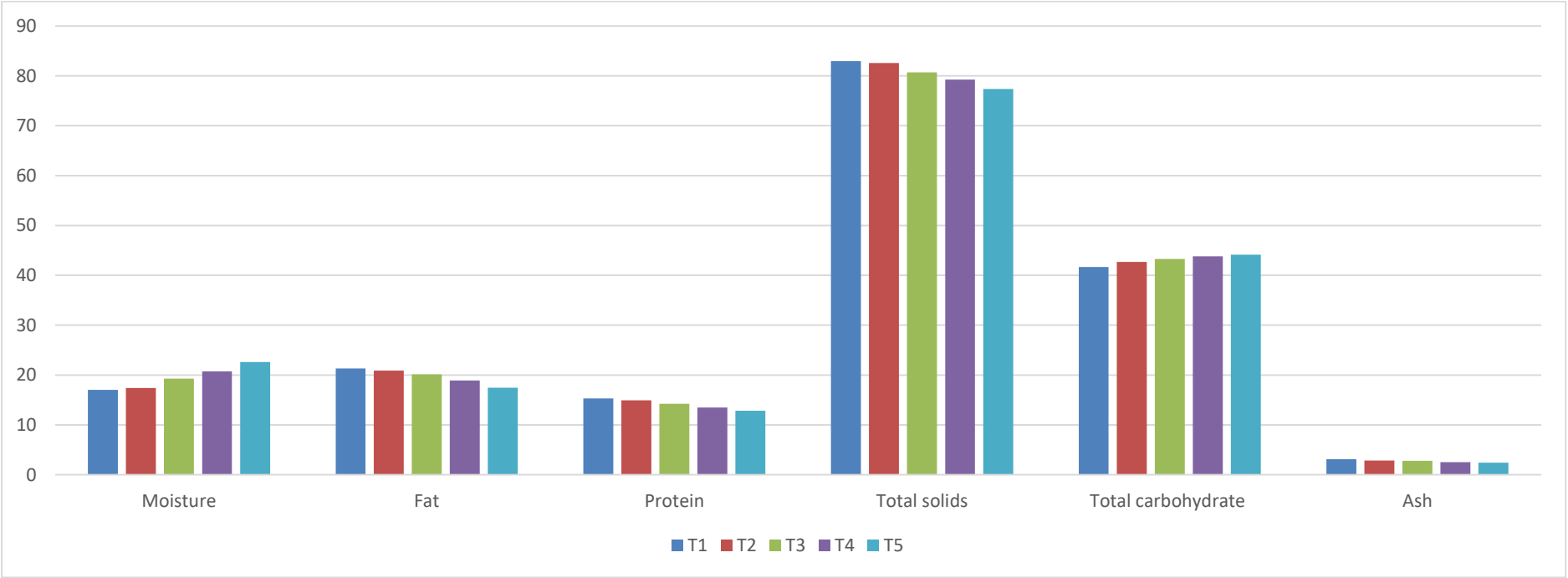


**Fig. 4.2.9: Per cent mean chemical composition of kinnow juice *kalakand***

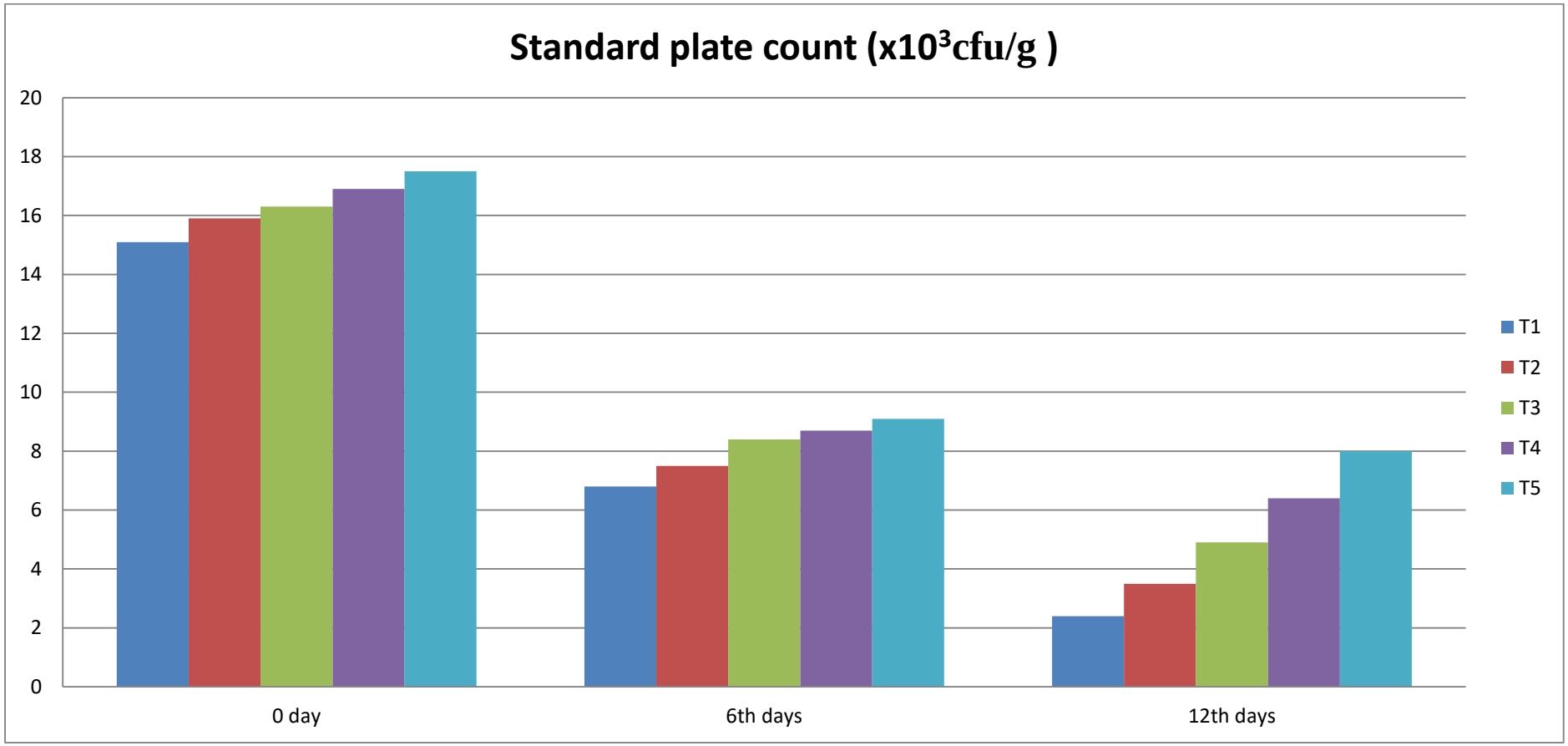


**Fig. 4.3.2 Standard plate count of *kalakand* with addition of various levels of kinnow juice**

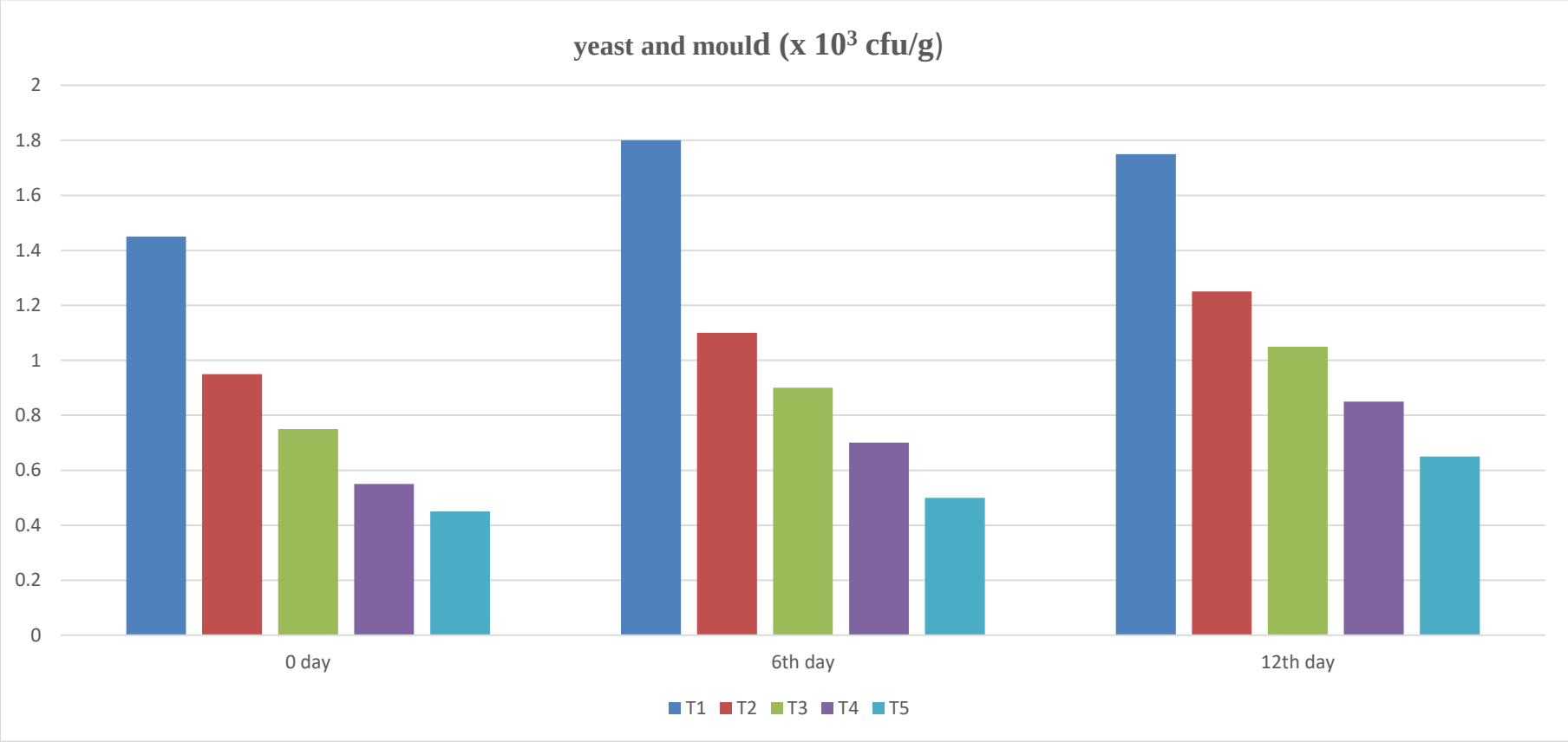


**Fig. 4.3.1: Yeast and mould count of *kalakand* with addition of various levels of kinnow juice.**

It is apparent from table 4.14 that the YMC content of *kalakand* are significantly affected due to addition of kinnow juice. The control sample $T_1$ had significantly maximum YMC counts ($1.45\times10^3$ cfu/g) over the rest of sample during storage. The YMC count of fresh sample range from 1.45 to $0.45 \times 10^3$cfu/g. It was decreased for treatment $T_1$ to $T_5$. On $6^{th}$ days range from 1.8 to $0.5 \times10^3$cfu/g and on $12^{th}$ days range from 1.75 to $0.65\times10^3$cfu/g for treatment $T_1$ to $T_5$. The sample $T_5$ had significantly minimum YMC count due to the moisture content as well as acidity of product. on storage period of 0 and 12th days YMC counts decrease from treatment $T_1$ to $T_5$. The research work showed that the level of kinnow juice increased with decrease in YMC count of *kalakand*.

The results obtained in analogous with those reported by Jadhav *et al*., (2014) of *lassi* with addition of orange juice and they found that the YMC in orange juice *kalakand* sample increased as storage period progressed up to 7 days.

### 4.3.3 Coliform count in *Kalakand* with addition of various levels of kinnow juice.

The results related to coliform count of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 percent ($T_2$, $T_3$, $T_4$ and $T_5$) were not found due to maintained condition.

## 4.4 Cost of production of kinnow juice *kalakand*

All the ingredients needed for preparation of *Kalakand* with addition of kinnow juice were rated as per the prevailing market prices during the year 2020-21. The cost of production of 1kg control *kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 percent ($T_2$, $T_3$, $T_4$ and $T_5$) were rated as per the prevailing market prices for the various items *viz.* milk, sugar, citric acid, kinnow while other miscellaneous charges as packaging, fuel and electricity etc. were worked on the basis of work performed for the preparation of 1 kg *kalakand* with addition of kinnow juice. The cost structure of *Kalakand* with addition of kinnow juice was apparent from Table 4.16 and graphically represented in Figure 4.16.

The cost production of 1 kg control *kalakand* ($T_1$) and *kalakand* prepared from different level of kinnow juice $T_2$, $T_3$, $T_4$ and $T_5$ were Rs. 330.72, 381.2, 419.14, 449.79 and 482.39, respectively. The cost of production *kalakand* ranged from Rs.

330.72 ($T_1$) to 482.39 ($T_5$) respectively. The cost of production of control *kalakand* sample was considerably less than *kalakand* prepared from kinnow juice. Increase level of kinnow juice showed increased in cost of production. These differences were mainly because of kinnow juice, buffalo milk, and sugar quantity. Yield of *kalakand* was also decreased from treatment $T_1$ to $T_5$ because total solid content of kinnow juice is less than milk.

Lowest cost of production (Rs.330.72) was calculated in case of treatment $T_1$ followed by treatment $T_2$ (Rs.381.2), $T_3$ (Rs.419.14), $T_4$ (Rs.449.79) and $T_5$ (Rs.482.39). However, best treatment selected by judge was $T_3$ (15 parts of kinnow juice) costing Rs. 419.14 per kg.

The results obtained are discord with those reported by Sawant (2007) formulation and evaluation of mango pulp *kalakand* and he found that the cost of production decrease with increase in mango pulp.

The results obtained are discord with those reported by Bhutkar (2015) of *kalakand* due to addition of ash gourd pulp and they found that the cost of production decrease with increase in level of ash gourd pulp. The cost of finished product was Rs.356 for control ($T_1$) *pedha* whereas, for other treatment $T_2$ (Rs. 343), $T_3$ (Rs. 331) and $T_4$ (Rs. 318) which indicates the addition of ash gourd pulp decreases cost of production.

**Table No. 4.16: Cost of production of kalakand with addition of kinnow juice**

| Sr. no. | Particulars | Cost (Rs.) | $T_1$ | | $T_2$ | | $T_3$ | | $T_4$ | | $T_5$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Qty. | Amt. | Qty. | Amt. | Qty. | Amt. | Qty. | Amt. | Qty. | Amt. |
| 1 | Buffalo milk (ml) | Rs.60/lit | 1000 ml | Rs.60 | 900 ml | Rs.54 | 850 ml | Rs.51 | 800 ml | Rs.48 | 750 ml | Rs.45 |
| 2 | Sugar (kg) | Rs.40/kg | 60 g | Rs.2.4 | 54 g | Rs.2.16 | 51 g | Rs.2.04 | 48 g | Rs.1.92 | 45 g | Rs.1.80 |
| | Citric acid | Rs.140/100g | 0.2g | Rs.0.28 | 0.2g | Rs.0.28 | 0.2g | Rs.0.28 | 0.2g | Rs.0.28 | 0.2g | Rs.0.28 |
| 4 | Kinnow juice | Rs.200/lit. | - | - | 100ml | Rs.20 | 150ml | Rs.30 | 200ml | Rs.40 | 250ml | Rs.50 |
| 5 | Miscellaneous charges (Rs.) | Rs.20 | - | Rs.20 | - | Rs.20 | - | Rs.20 | - | Rs.20 | - | Rs.20 |
| 6 | Quantity of *kalakand* obtained | - | 250g | - | 247.7g | - | 246.5g | - | 245.4g | - | 244.2g | - |
| 7 | Total cost for obtained product | - | - | 82.68 | - | 94.44 | - | 103.32 | - | 110.2 | - | 117.08 |
| 8 | Total cost per kg (Rs.) | - | - | 330.72 | - | 381.2 | - | 419.14 | - | 449.79 | - | 482.39 |

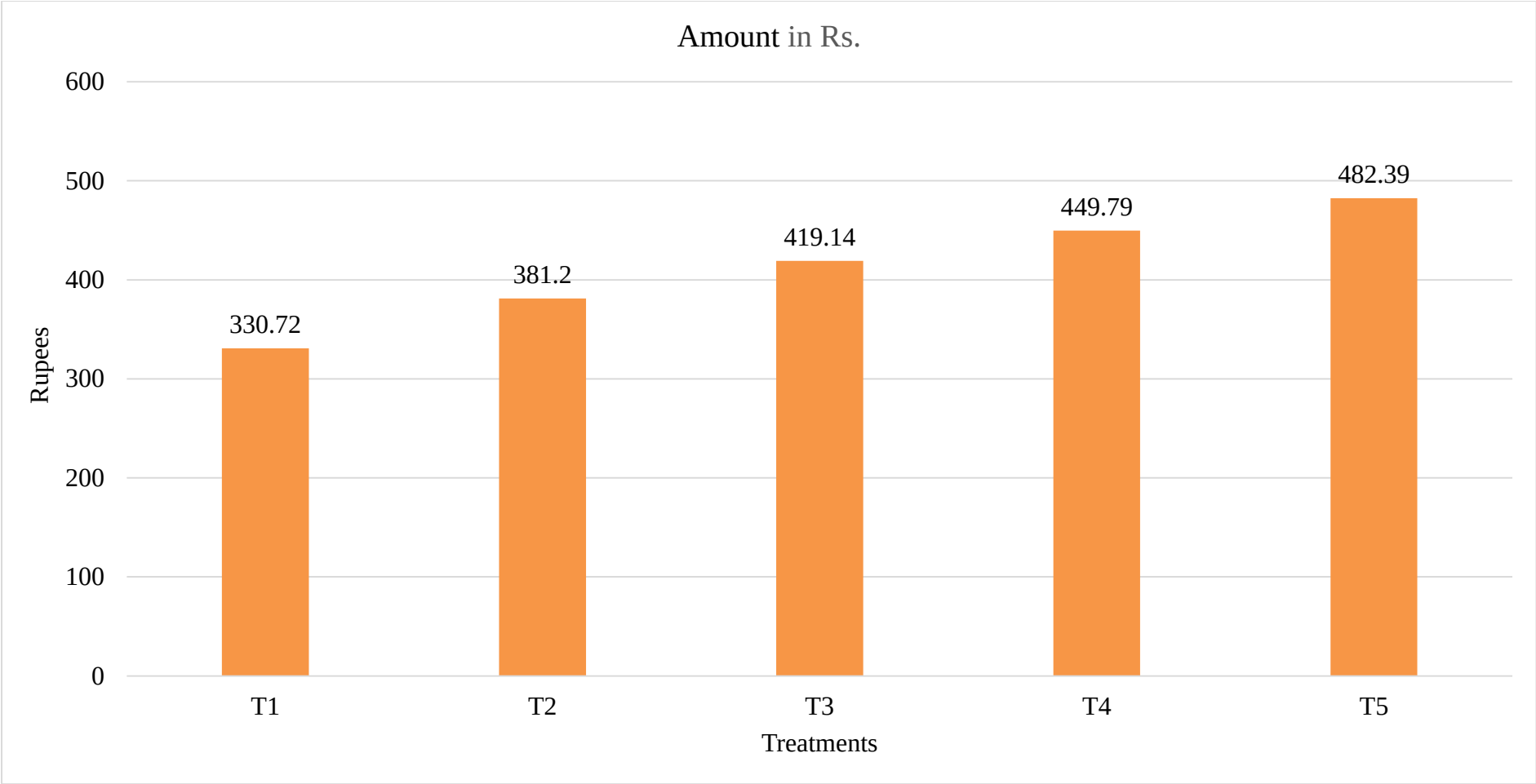


**Fig. 4.4: Cost of production of kinnow juice *kalakand*.**

# CHAPTER-V

# SUMMARY AND CONCLUSIONS

## CHAPTER - V

# SUMMARY AND CONCLUSIONS

The research work carried out on "Studies on Preparation of *kalakand* with addition of kinnow juice" with different proportion are summarized in following objective

5.1 Sensory qualities of *kalakand*

5.2 Chemical composition of *kalakand*

5.3 Shelf life of *kalakand*

5.4 Cost of production of *kalakand*

### 5.1 Sensory qualities of *kalakand*

#### 5.1.1 Colour and appearance of *kalakand*

The colour and appearance score for various treatments of kinnow juice ranged between 7.69 to 8.57. The score for treatment $T_3$ (8.57) was maximum followed by $T_1$ (8.51), $T_2$ (8.44), thereafter it was decreased from treatment $T_4$ (8.23) and $T_5$ (7.69). The acceptable highest score was for $T_3$ (8.57) which has 15 parts of kinnow juice. The lowest score was for treatment $T_5$ (7.69) which has 25 parts of kinnow juice.

#### 5.1.2 Body and texture of *kalakand*

The body and texture score for various treatments of kinnow juice ranged between 7.91 to 8.58. The score for treatment $T_3$ (8.58) was maximum followed by $T_2$ (8.42), $T_1$ (8.26), Thereafter it was decreased from treatment $T_4$ (8.22) and $T_5$ (7.91). The acceptable highest score was for treatment $T_3$ (8.58) which has 15 parts of kinnow juice. The lowest score was for treatment $T_5$ (7.91) which has 25 parts of kinnow juice and formed more granular texture in *kalakand* with increasing acidity. The results showed that the treatment $T_3$ (15 parts of kinnow juice) indicated that they alter significant body and texture, whereas increasing level of kinnow juice which affect body and texture of *kalakand* they form sticky body and big granular texture.

This might be due to the increase in moisture content and acidity in *kalakand* with addition of kinnow juice.

### 5.1.3 Flavour of *kalakand*

The flavour score for various treatments of kinnow juice ranged between 7.91 to 8.49. The flavour score for treatment $T_3$ (8.49) was maximum followed by $T_2$ (8.25), $T_4$ (8.19), $T_1$ (8.17) and $T_5$ (7.91). The acceptable maximum score was treatment $T_3$ (8.49) which has 15 parts of kinnow juice. The lowest score was recorded in treatment $T_5$ (7.91) which contain 25 parts of kinnow juice formed maximum acidity content. This showed that as the level of kinnow juice increases, the flavour score of *kalakand* also increases to treatment $T_3$ (15 parts of kinnow juice), but in treatment $T_4$ (20 parts of kinnow juice) and $T_5$ (25 parts of kinnow juice) the flavour score decreases. It showed that the level of kinnow juice at treatment $T_3$ are the best as compare to rest of all treatments.

### 5.1.4 Overall acceptability of *kalakand*

The Overall acceptability score for various treatments ranged between 7.83 to 8.54. The score for treatment $T_3$ (8.54) was maximum followed by $T_2$ (8.37), $T_1$ (8.31), $T_4$ (8.19), and $T_5$ (7.83). The acceptable maximum score was for treatment $T_3$ (8.54) which has 15 parts of kinnow juice. The lowest score was recorded in treatment $T_5$ (7.83) which contain 25 parts of kinnow juice. Since the score of all the samples were above 5.5, it was defined that kinnow juice which prepared under all treatments were acceptable. Total sensory score of kinnow juice *kalakand* differed significantly due to the different levels of kinnow juice added. Among all the samples, $T_3$ sample has greasier with grainy texture, good flavour with no deleterious effect on colour and appearance. It was having significant natural flavour of kinnow juice and smooth to granular texture. Therefore, it was liked by all judges among all the treatments including control sample.

## 5.2 Chemical composition of *kalakand*

### 5.2.1 Moisture content of *kalakand*

The moisture content of *kalakand* are lowest for treatment $T_1$ and it increased gradually to treatment $T_5$. The moisture content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$

were 17.05, 17.40, 19.30, 20.75 and 22.63 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the moisture content 19.30 per cent. The moisture content of *kalakand* increased in treatment $T_3$ (19.30 per cent) as compare to $T_2$ (17.40 per cent) and $T_1$ (17.05 per cent), also increased in treatment $T_4$ (20.75 per cent) and $T_5$ (22.63 per cent). As kinnow juice level increases, moisture content in *kalakand* increased and vice-versa.

### 5.2.2 Fat content of *kalakand*

The fat content of *kalakand* was significantly affected due to addition of kinnow juice. The average fat content was significantly highest for treatment $T_1$ (21.33 per cent) and it decreased gradually to $T_5$ (17.48 per cent). The fat content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 21.33, 20.90, 20.14, 18.89 and 17.48 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the fat content 20.14 per cent. The fat content of *kalakand* decrease in treatment $T_3$ (20.14 per cent) as compare to $T_2$ (20.90 per cent) and $T_1$ (21.33 per cent), also decrease in treatment $T_4$ (18.89 per cent) and $T_5$ (17.48 per cent). As kinnow juice level increased, fat content in *kalakand* decreased and vice-versa.

### 5.2.3 Protein content of *kalakand*

The protein content of *kalakand* are significantly affected due to addition of kinnow juice. The average protein content was significantly highest in treatment $T_1$ (15.30 per cent) and it decreased gradually to treatment $T_5$ (12.84 per cent). The protein content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 15.30, 14.94, 14.22, 13.51 and 12.84 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the protein content 14.22 per cent. The protein content of *kalakand* decrease in $T_3$ (14.22 per cent) as compare to $T_2$ (14.94 per cent) and $T_1$ (15.30 per cent), whereas decreased in $T_4$ (13.51 per cent) and $T_5$ (12.84 per cent). As kinnow juice level increased, protein content in *kalakand* decreased and vice-versa.

### 5.2.4 Total solids content of *kalakand*

The total solids content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum total solids content in treatment $T_1$ (82.95 per cent), whereas minimum in treatment $T_5$ (77.38 per cent). The total solids content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 82.95, 82.60, 80.70, 79.25 and 77.38 per cent

respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the total solids content 80.70 per cent. Total solids content of *kalakand* decreased in $T_3$ (80.70 per cent) as compare to treatment $T_2$ (82.60 per cent) and $T_1$ (82.95 per cent). It is indicated that as the kinnow juice level increased, total solid content in *kalakand* decreased. This might be due to decreased in fat and protein content in *kalakand*.

### 5.2.5 Total carbohydrate content of *kalakand*

The total carbohydrate content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum total carbohydrate content in treatment $T_5$ (44.14 per cent), whereas minimum in treatment $T_1$ (41.67 per cent). The total carbohydrate content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 41.67, 42.70, 43.28, 43.80 and 44.15 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the total carbohydrate content 43.28 per cent. The total carbohydrate content of *kalakand* increase in $T_3$ (43.28 per cent) as compare to $T_2$ (42.70 per cent) and $T_1$ (41.67 per cent) also increased in treatment $T_4$ (43.80 per cent) and $T_5$ (44.15 per cent). It is indicated that as the kinnow juice level increased, total carbohydrate content in *kalakand* increased.

### 5.2.7 Ash content of *kalakand*

The ash content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum ash content in treatment $T_1$ (3.10 per cent), whereas minimum in treatment $T_5$ (2.43 per cent). The ash content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 3.10, 2.85, 2.80, 2.55 and 2.43 per cent respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the ash content 2.80 per cent. The ash content of *kalakand* decreased in $T_3$ (2.80 per cent) as compare to $T_2$ (2.85 per cent) and $T_1$ (3.10 per cent) whereas, decreased in treatment $T_4$ (2.55 per cent) and $T_5$ (2.43 per cent). It is indicated that as the kinnow juice level increased, ash content in *kalakand* decreased.

### 5.2.7 Acidity content of *kalakand*

The acidity content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum acidity content in treatment $T_5$ (0.75 per cent), while minimum in treatment $T_1$ (0.33 per cent). The acidity content of treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 0.33, 0.38, 0.52, 0.59 and 0.75 per cent respectively. The treatment $T_3$

(15 parts of kinnow juice) recorded the acidity content 0.52 per cent. The acidity content of *kalakand* increased in $T_3$ (0.52 per cent) as compare to $T_2$ (0.35) and $T_1$ (0.33 per cent), whereas increased in treatment $T_4$ (0.59 per cent) and $T_5$ (0.75 per cent). It is indicated that as the kinnow juice level increased, acidity content in *kalakand* increased.

### 5.2.8 pH content of *kalakand*

The pH content of *kalakand* was significantly affected due to addition of kinnow juice. The maximum pH content for treatment $T_1$ (6.74) while minimum pH content in treatment $T_5$ (6.05). The pH content for treatment $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ were 6.74, 6.59, 6.40, 6.21 and 6.05, respectively. The treatment $T_3$ (15 parts of kinnow juice) recorded the pH content 6.40 per cent. The pH content of *kalakand* decrease in $T_3$ (6.40) as compare to $T_2$ (6.59) and $T_1$ (6.74), whereas decreased in $T_4$ (6.21) and $T_5$ (6.05). It is indicated that as the kinnow juice level increased, pH content in *kalakand* decreased. This might be due to higher pH content in kinnow juice as compare to buffalo milk *kalakand*.

## 5.3 Shelf life of *kalakand*

Storage study was conducted at refrigerated (7±2ºC) temperature conditions. The sample was evaluated for microbiological changes at 6 days interval up to $12^{th}$ days at refrigerated temperature. Microbiological parameter was determined by standard plate count (SPC), yeast and mould (YMC) and coliform count.

### 5.3.1 Standard plate count (SPC) count

SPC of *kalakand* are significantly affected due to addition of kinnow juice. It was observed that the SPC of control ($T_1$) *kalakand* decreased 15.10 to 2.4 $\times 10^3$cfu/g for 0 to $12^{th}$ days. For treatment $T_2$ count ranges from 15.90 to $3.5\times10^3$cfu/g, $T_3$ count 16.30 to 4.9 $\times$ $10^3$cfu/g, $T_4$ count 16.90 to 6.4 $\times$ $10^3$ and $T_5$ count 17.50 to $8.0\times10^3$cfu/g for 0 to $12^{th}$ days. The control sample $T_1$ had significantly minimum SPC counts i.e. $15.10\times10^3$ followed by $T_2$ ($15.90\times10^3$), $T_3$ ($16.30\times10^3$), $T_4$ ($16.90\times10^3$) and $T_5$ ($17.50\times10^3$) on fresh sample. The SPC count of fresh sample range from 15.10 to 17.50 $\times10^3$cfu/g for treatment $T_1$ to $T_5$. On $6^{th}$ days range from 6.8 to 9.1 $\times10^3$cfu/g and on $12^{th}$ days range from 2.4 to 8.0 for treatment $T_1$ to $T_5$. The sample $T_5$ had significantly maximum SPC count on fresh sample, $6^{th}$ days and $12^{th}$

days due to the moisture content as well as acidity of product. On storage period of 1st and 12th days SPC counts increase from treatment $T_1$ to $T_5$. The research work showed that the level of kinnow juice increase with increase in SPC count of *kalakand*. The SPC in *kalakand* sample decreased as storage period progressed up to 12 days.

### 5.3.2 Yeast and mould count *(*YMC*)* content of *kalakand*

The YMC of *kalakand* are significantly affected due to addition of kinnow juice. It was observed that the YMC of control ($T_1$) *kalakand* increased 1.45 to 1.75 × $10^3$cfu/g for 0 to 12th days. For treatment $T_2$ count ranges from 0.95 to 1.25 ×$10^3$cfu/g, $T_3$ count 0.75 to 1.05×$10^3$cfu/g, $T_4$ count 0.55 to 0.85×$10^3$cfu/g and $T_5$ count 0.45 to 0.65×$10^3$cfu/g for 0 to 12th days. The YMC count of fresh sample range from 1.45 to 0.45 ×$10^3$cfu/g for treatment $T_1$ o $T_5$. On 6th days range from 1.8 to 0.5×$10^3$cfu/g and on 12th days range from 1.75 to 0.65×$10^3$cfu/g for treatment $T_1$ to $T_5$. The sample $T_5$ had significantly minimum YMC count due to the moisture content as well as acidity of product. Storage period of 0 and 12th days YMC counts decrease from treatment $T_1$ to $T_5$. The research work showed that the level of kinnow juice increase with decrease in YMC count of *kalakand*.

### 5.3.3 Coliform count of *kalakand*

The results related to coliform count of control *Kalakand* ($T_1$) and *Kalakand* prepared from different level of kinnow juice viz. 10, 15, 20 and 25 percent ($T_2$, $T_3$, $T_4$ and $T_5$) were not found due to maintained condition.

## 5.4 Cost of production of *kalakand*

The cost production of 1 kg control *kalakand* ($T_1$) and *kalakand* prepared from different level of kinnow juice $T_2$, $T_3$, $T_4$ and $T_5$ were Rs.330.72, 381.2, 419.14, 449.79 and 482.39 respectively. The cost of production *kalakand* ranged from Rs.330.72 ($T_1$) to 482.39 ($T_5$). The cost of production of control *kalakand* sample was considerably less than *kalakand* prepared from kinnow juice. Increase level of kinnow juice showed slightly increase in cost of production. These differences were mainly because of kinnow juice, buffalo milk, and sugar quantity. Lowest cost of production (Rs.330.72) was calculated in case of treatment $T_1$ followed by treatment $T_2$ (Rs.381.2), $T_3$ (Rs.419.14), $T_4$ (Rs.449.79) and $T_5$ (Rs.482.39). However, best

treatment selected by judge was $T_3$ (15 parts of kinnow juice) costing Rs. 419.14 per kg.

## CONCLUSION

The level of addition of kinnow juice (10, 15, 20 and 25 part) was standardized on the sensory score for higher and lower level than the standardized level of kinnow juice addition.

Addition of kinnow juice in *kalakand* increased moisture, total carbohydrates and acidity while decreased fat, protein, total solids and ash content significantly in finished product as compare to control.

From the results of present investigations, it was revealed that:

1) Kinnow juice could be successfully used in preparations of dairy product like *kalakand*.
2) Use of kinnow juice treatment $T_3$ (15 parts of kinnow juice) of *kalakand* preparation was more acceptable and desirable.
3) According to evaluation scores, it was observed that treatment $T_3$ (15 parts of kinnow juice) was acceptable than other treatments with respect to colour and appearance, body and texture, flavour and overall acceptability.
4) While in chemical composition scores, control ($T_1$) was acceptable and liked very much but as compared to other treatment levels, $T_3$ with 15 parts of kinnow juice gained acceptable score with like very much score. Hence, it is concluded that treatment $T_3$ is more nutritious and cheaper for consumers.
5) The chemical composition of $T_3$ contains moisture 19.30 per cent, fat 20.14 per cent, proteins 14.22 per cent, ash 2.80 per cent, titratable acidity 0.52 per cent LA, total carbohydrate 43.30 per cent, total solids 80.70 per cent and pH 6.40.
6) In microbial analysis SPC count increased, YMC count decreased with increase level of kinnow juice and coliform count are not detected on storage period.
7) Although, the cost of *kalakand* with addition of kinnow juice was more than cost of controlled product ($T_1$).

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# LITERATURE CITED


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# APPENDIX

# APPENDIX - I

**DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRY SCIENCE**

**COLLEGE OF AGRICULTURE,**

**VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH, PARBHANI**

**"Studies on preparation of *kalakand* with addition of kinnow juice."**

**(9-Point Hedonic Scale)**

**Name of the product** : Preparation of *kalakand* with addition of kinnow juice

**Name of evaluator** : .....

**Designation** : .....

**Score evaluation card**

| Treatment | Flavour | Colour and Appearance | Body and texture | Overall acceptability |
|---|---|---|---|---|
| $T_1$ | | | | |
| $T_2$ | | | | |
| $T_3$ | | | | |
| $T_4$ | | | | |
| $T_5$ | | | | |

**Hedonic rating scale (9-point Hedonic Scale).**

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

**Remark:**

**Signature:**

# CURRICULUM VITAE

# CURRICULUM VITAE

| | | |
|---|---|---|
| Name of the candidate | : | Govind Vyankati Maske |
| Date of Birth | : | 14/04/1997 |
| Nationality | : | Indian |
| Department | : | Dairy Science (AHDS) |
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| Email.id | : | gmaske0953@gmail.com |
| Title of the thesis | : | "Studies on Preparation of *Kalakand* with Addition of Kinnow Juice" |

**Academic qualification**

| Course / Degree | Name of the college / Institute | University / Board | Year of passing | Percentage (%) CGPA | Class / Grade |
|---|---|---|---|---|---|
| SSC | Gandhi Vidyalay, Ekata nagar, Parbhani. | Aurangabad Board | 2013 | 73.80 % | First class |
| HSC | Dnyanopasak Shiikshan mandal, college of Art, Commerce and Science, parbhani. | Aurangabad Board | 2015 | 73.38 % | First class |
| B.Sc (Agri.) | College of Agriculture, Parbhani. | VNMKV,Parbhani | 2019 | 74.70 % | Second class |

Place: Parbhani

Date: 25 / 02 /2022

**(Govind V. Maske)**

**Reg. No: 2019A/83M**