PREPARATION OF PANEER WHEY BEVERAGE BLENDED WITH SUGARCANE (*Saccharum officinarum*) JUICE

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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(DAIRY SCIENCE)

By
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Enrolment Number -PP-3305 **2019**

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the Thesis entitled **"PREPARATION OF PANEER WHEY BEVERAGE BLENDED WITH SUGARCANE (*Saccharum officinarum*) JUICE"** or part thereof has neither been submitted for any other degree or diploma of any University, nor the data has been derived from any thesis / publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place: Akola

Date: / / 2019

(Lashkare Siddheshwar Vishwanath)

Enrolment No. PP-3305

CERTIFICATE

This is to certify that thesis entitled **"PREPARATION OF PANEER WHEY BEVERAGE BLENDED WITH SUGARCANE (*Saccharum officinarum*) JUICE"** submitted in partial fulfilment of the requirement for the degree of **"Master of Science in Agriculture (Animal Husbandry and Dairy Science) in Dairy Science"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Lashkare Siddheshwar Vishwanath** under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

Place: Akola

Date: / / 2019

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(D) Abbreviations

%	-	Per cent
/	-	Per
@	-	At the rate of
&	-	And
<	-	Less than
>	-	More than
AOAC	-	Association of Official Analytical Chemists
BIS	-	Bureau of Indian Standard
°C	-	Degree Celsius
CD	-	Critical Difference
CV	-	Coefficient of Variance
Dr. PDKV	-	Dr. Panjabrao Deshmukh Krishi Vidyapeeth
d.f.	-	Degrees of freedom
Ed.	-	Edition
et al.	-	And others
etc	-	etcetera (and other things)
FAO	-	Food and Agriculture Organization
Fig.	-	Figure
gm	-	Gram
Hrs	-	Hour(s)
i.e.	-	id est (that is)
ISI	-	Indian Standard Institution
J.	-	Journal
Kg	-	Kilogram
Kcal	-	Kilocalorie

Lit	-	Litre
Max	-	Maximum
Min	-	Minimum
mg		Milligram
µg	-	Microgram
MT	-	Million Tonnes
ml	-	Millilitre
NDDB	-	National Dairy Development Board
NS	-	Non Significant
ppm	-	Part Per Million
Rs/₹	-	Rupees
Sci.	-	Science
SE(m)	-	Standard error of mean
SIG	-	Significant
TS	-	Total Solids
viz.,	-	Namely

(E) THESIS ABSTRACT

a)	Title of the Thesis	:	**"Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice"**
b)	Full name of student	:	**Lashkare Siddheshwar Vishwanath**
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i)	Signature of student	:	
j)	Signature, Name and address of forwarding authority	:	(**Dr. S. D. Chavan)** Head, Department of Animal Husbandry and Dairy Science Post Graduate Institute Dr. P. D. K. V., Akola

ABSTRACT

The present investigation entitled "Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice" was undertaken in Department of Animal Husbandry and Dairy Science and Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao

Deshmukh Krishi Vidyapeeth, Akola with a view to utilize valuable, nutritious paneer whey with sugarcane juice for preparation of paneer whey beverage, to evaluate sensory quality, to analyze physico-chemical properties and to study the cost of production of paneer whey beverage with different levels of sugarcane juice.

The paneer whey beverage was prepared by using different levels of sugarcane juice @ 0, 5, 15, 25 and 35 in treatments T_1, T_2, T_3, T_4 and T_5 respectively. In that addition of 5 per cent sugar in proportion to whey, ginger juice 0.5 per cent and lemon juice 0.05 per cent added in all the treatments. The overall acceptability of paneer whey beverage prepared with 25 per cent sugarcane juice level (T_4) was significantly superior and more acceptable than other levels of sugarcane juice. The chemical composition study shows that protein, total solids and acidity increased while fat and pH decreased with increasing levels of sugarcane juice in paneer whey beverage.

The manufacturing cost of sugarcane juice based paneer whey beverage product calculated on the basis of prevailing market rates of ingredients, was laid in the range of ₹ 7.50 to ₹ 23.95 /lit. Increased level of sugarcane juice showed the increasing trend in cost of production of paneer whey beverage. The cost of production sensorily best treatment (T_4) was ₹ 19.25 /lit. Based on 200 ml beverage bottle, the cost of production of treatment T_4 was only ₹ 3.85, which seems to be very cheaper as compared to different soft drinks or beverages sold in market.

CHAPTER I

INTRODUCTION

1.1 Background information

It is universally accepted that, the milk is nearly complete food for neonates in animal as well as human beings of all ages. Milk contains rich source of almost all essential nutrients in proper proportion for growth and development of human being. India, at present is the world's largest milk producer 176.3 MT in the year, 2017-18. (NDDB, India, 2018). It contributes about 21.32 per cent of the global milk production. This has been largely achieved through a combination of constructive policies and institutional network, which has been supported to the millions of rural milk producers, through small scale dairy farming.

About, 46 per cent milk is consumed as fluid, 50 per cent is converted into various indigenous milk products and about 4 per cent milk is converted into the manufacturing of western type of milk products i.e. yoghurt, ice-cream, milk powder etc. (Anonymous, 2009). Out of that 3 per cent milk is used for production of acid coagulated milk products i.e. chakka, channa and paneer.

Dairy industry has emerged as a fast growing and large scale producer of novel and nutritionally enriched milk based products, with proficient, which is a very good achievement in the world market. Indigenous milk products i.e. fermented, acid coagulated and by-products like whey, skim milk butter milk, ghee residue are noticeable since time immemorial. Right now these milk based products are reproducing into various newer generations products with improving its characteristics and dietetic properties.

Whey based products exist and get hold of positively to this innovative groups. Whey is the watery part of milk that remains after separation of curd or coagulated products that result from acid or proteolytic enzyme mediated coagulation of milk. It is major by-product of

dairy industry, during manufacture of products like paneer, channa, chakka, cheese, casein, etc. In the manufacturing of these products, about 10- 20 per cent portion of milk is recovered as the desired end product and remaining 80-90 per cent liquid portion is the whey. It is considered to be reliable source of number of high quality and biological active proteins, carbohydrates and minerals. The current world production of whey is estimated at about 165 million tonnes (Anonymous, 2010). In India, nearly 5 million tonnes whey is produced of which channa and paneer whey contribute around 80 per cent of total whey (Gupta, 2008) and majority of it is disposed of as a waste.

1.2 Importance of study

Ready-to-drink beverages offer the advantages of convenience and portability to today's busy consumers. Carbonation category includes both refrigerated and shelf stable beverages demand is stronger for shelf-stable products which offer ease of distribution and storage. Whey proteins are often the preferred source for ready-to drink protein beverages because of their excellent nutritional qualities, bland flavour, ease of digestibility, and unique functionality in beverage systems. Five general trends have influenced food and beverage innovations since 1985 i.e. convenience, pleasure, ethnic fusion, tradition and importantly, health and wellness. Whey beverages are generally classified into four basic types, mixtures of whey (processed or unprocessed) with fruit or (rarely) vegetable juices; dairy-type, 'thick' beverages (fermented or unfermented); thirst-quenching carbonated beverages (the 'Rivella type'); and alcoholic beverages (beer, wine or liqueurs).

Whey proteins are good testing, versatile and highly functional ingredients and therefore provides essential benefits to food and beverage manufacture as they create nutritious and delicious products that consumers are demanding. Whey proteins provide highest quality absorption characteristics as well as sulphur containing essentially branched chain amino acids like leucine, isoleucine and valine which are important in growth and repair of tissue, improved muscle strength and body composition (Khare *et al.,* 2007).

Whey has protective and curative facet to treat against different diseases such as jaundice, infected lesion of skin, gonorrhoea, arthritis, anaemia, liver complaints, antioxidative action, anticarcinogenic activity and act against HIV infection (Gandhi and Dixit, 2008). Despite of significant gains, more than 70 per cent of whey is being thrown away as waste in gutter, through which more than 50 per cent of milk solids losses as waste.

1.3 Objectives of study

The present investigation on “Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice” was undertaken with following objectives.

1. To standardize the process for preparation of paneer whey beverage blended with sugarcane juice
2. To evaluate the quality by sensory evaluation
3. To determine physico-chemical properties
4. To calculate the cost structure

1.4 Scope and limitations

Since, last twenty years India progressed in milk production as well as emerged as the top fruit producer in the world, but distressing aspect is that as much as fruit produced in India get spoiled due to lack of infrastructure facilities as well as appropriate post-harvest technology. So, formulation of a new product using suitable combination of whey and fruit juices both in concentrated and dried forms would permit economic utilization of whey and value addition to high income.

According to Khamuri and Rajorhia (1998) the simplest whey based fruit drinks are manufactured by mixing pre-determined fruit pulp or juice and minimally processed whey. Beverages of this type have been formulated in different parts of the world. Acid whey is most suitable for blending with fruit juices to produce cloudy, still fruit drink. A pH of less than 4.0 is necessary to prevent protein coagulation during pasteurization. The pH reduction can be achieved by addition of lactic or other organic acid.

Sugarcane is an important industrial crop cultivated in tropical and subtropical regions of the world. India is the second largest producer of sugarcane next to Brazil. Sugarcane has been used as sweetener for millennia and today refined sugar is used in copious quantities to supplement the natural sugar (fructose) found in fruits and vegetables (Phanikumar, 2011). A part of sugarcane juice consumed as expensive and pleasing beverages in India. It possesses therapeutic value (Banerji *et al*., 1997). Sugarcane juice is commonly used as delicious drink in both urban and rural areas. Sugarcane juice of 100 ml provides 40 kcal of energy, 10 milligram of iron and 6 microgram of carotene (Parvathy, 1983). Sugarcane juice is rich in enzyme and has many medicinal properties. It contains water 75-85 per cent, reducing sugar 0.3-3.0 per cent, non-reducing sugar 10-21 per cent (Swaminathan, 1995). Sugarcane juice is a great preventive and healing source for sore throat, cold and flu. It has a low glycemic index which keeps the body healthy. Even the diabetic can enjoy this one sweet drink without fear. It is because it has no simple sugars. It hydrates the body quickly when exposed to prolong heat and physical activity. It is excellent substitutes for aerated drinks and cola, it refreshes and energizes the body instantly as it is rich in carbohydrates. Lemon is natural clarifiers as well as increases the flavour of sugarcane juice. A heavy precipitate forms which is separated from the juice in the clarifier (Prasad and Nath, 2002). The insoluble particulate mass, called “mud”, is separated from the limed juice by gravity or centrifuge. Ginger is main role of juice antimicrobial agent as well as good stability and flavour provide. In general sugarcane juice is spoiled quickly by the presence of simple sugars. The sugarcane juice can be introduced as delicious beverages by preventing the spoilage of juice with appropriate method. Biodegradation is caused by microorganisms mainly *Leuconostoc sp.* (*L. mesenteroides* and *L. dextranium*) also takes place. Soon after the harvest of sugarcane; endogenous invertase enzyme is activated and acts as cause of deterioration. These organisms convert sucrose into polysaccharides, such as dextran even in very small amount creates problems of filtration, clarification, crystallization and alters the shape of sugar crystals thereby

affecting the quality of sugar (Krishnakumar and Devadas, 2006) acceptability.

Using paneer whey as a beverage in human nutrition, especially for therapeutic purposes, can be traced back to the ancient Greeks; Hippocrates, in 460 B.C. (Before Christ) prescribed whey for an assortment of human ailments. The market dynamics is driven by five key factor groupings: increased concentration in the global beverages market, diverging functional beverage trends worldwide, flavour innovations, product differentiation and cross-category innovations. Whey beverages are manufactured and formulated keeping in consideration the nutritional values, biological and functional properties.

1.5 Hypothesis

Very scantly information is available on whey systems of Indian dairy industry i.e. paneer, chakka and channa whey. Looking forward with disposal problems and to harness the benefits of nutritious solids of the whey diversified efforts are needed. With this hypothesis the present investigation entitled ‘Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice’ was planned for the research work.

CHAPTER II

REVIEW OF LITERATURE

Whey is one of the most important byproduct of the dairy industry but the pollution due to whey is a big problem. Utilization of whey for the production of beverages, soft drinks and wines is one of the solutions to the pollution problem.

Efforts have been made to review the literature in respect of whey systems and their composition, technology, cultures used and quality of soft drinks in particular and some related products in general.

2.1 Functional and nutritional value of sugarcane juice

2.2 Physico-chemical properties of whey and whey beverage

2.3 Technology for whey beverage

2.4 Sensory evaluation of whey beverage

2.5 Cost of production of whey beverage

2.1 Functional and nutritional value of sugarcane juice

Kadam *et al.* (2007) studied the sugarcane (*Saccharum officinarum*) juice is widely consumed by people of the tropics and subtropics. It has been used to cure jaundice and liver-related disorders in Indian systems of medicine. Its possible mechanism of action was examined in terms of antioxidant availability. The aqueous extracts of three varieties of sugarcane were studied. These varieties showed good antioxidant properties and were also able to protect against radiation induced DNA damage in pBR322 plasmid DNA and *Escherichia coli* cultures.

Jaffe (2012) observed that, Non-centrifugal sugar (NCS), the technical name of the product obtained by evaporating the water in sugar cane juice. Scientific research has been confirming that NCS has multiple health effects but it is still practically outside the current focus on functional foods and nutriceuticals. The highest frequency is immunological effects 26 per cent, followed by anti-toxicity and cytoprotective effects 22 per cent,

anticariogenic effects 15 per cent and diabetes and hypertension effects 11 per cent. Some of these effects can be traced to the presence of Fe and Cr, and others are suggested to be caused by antioxidants.

Syed *et al.* (2014) studies investigated the antioxidant and phenolic composition of sugarcane. The leaves and juices of thirteen varieties of sugarcane were studied for their antioxidant activity and protective effect on DNA damage. 2, 2-Diphenyl-1 picrylhydrazyl radical (DPPH) assay was used to determine the radical scavenging activities in leaves and juices. Different varieties of sugarcane showed good antioxidant properties.

Jaffe (2015) reported that, Non-centrifugal cane sugar (NCS) (panela, jaggery, kokuto, etc.) is a traditional sweetener of increasingly economic importance after a long process of displacement by refined sugar. The analytical literature with the different local names of NCS (jaggery, gur, kokuto, panela, chancaca, piloncillo, rapadura, muscovado, unrefined sugar, black sugar) as key-words, this review identified the published data on its content of 7 proximate, 14 minerals, and 13 vitamins so to calculate its average and median values, as well as list its contents of potentially relevant functional components like phenolics, amino acids, complex sugars and others.

Ullah *et al*. (2015) antioxidant characteristics of ice cream supplemented with sugarcane juice were investigated. An original 13 per cent sucrose content in ice cream was supplemented with 20, 40, and 60 per cent sugarcane juice (82, 164, and 246 ml/lit., treatments T_1, T_2, and T_3, respectively). Addition of sugarcane juice to ice cream inhibited oxidation of unsaturated fatty acids during storage for 180 days with no effect on sensory characteristics for the T_1 and T_2 treatment levels.

2.2 Physico-chemical properties of whey and whey beverage

Paul (1990) reported that, the chemical composition of whey as 93 per cent moisture, 0.5 per cent fat, 0.4 per cent protein, 5.1 per cent lactose, 0.4 per cent ash and 0.2 per cent acidity.

Kesarkar (2002) studied that, the method for preparation of pineapple flavoured paneer whey beverage. The finished product contained 18.68, 0.32, 0.31, 2.02, 15.56, 17.58, 0.47 and 0.66 per cent TS, fat, reducing sugar, non-reducing sugar, total sugar, ash and acidity, respectively and pH of finished product was 4.47.

Saravanakumar and Manimegalai (2002) reported that, paneer whey contained 7 per cent total solids, 0.1 per cent acidity, 5.2 pH and 5.2 per cent total sugars.

Shukla *et al.* (2004) studied that, the physico-chemical composition of fruit beverages using paneer whey and observed that, mango flavoured beverage contained 662.50 cp viscosity, 16.73 per cent total solids, 0.60 per cent acidity, 0.27 per cent protein and pH 4.47. Apple flavoured beverage contained 22.50 cp viscosity, 15.22 per cent total solids, 0.54 per cent acidity, 0.34 per cent protein and pH 4.98.

Suresha and jayaprakasha (2004) reported that, the physico-chemical properties of lactose hydrolyzed and unhydrolyzed whey permeate beverage that pineapple flavoured beverage contained 12.80 per cent sugar, 0.1 per cent acidity, 0.56 per cent ash, 4.48 pH, 1.057 specific gravity and 1.255 cp viscosity. The mango flavoured beverage contained 13.91 per cent total solid, 0.31 per cent protein, 5 per cent lactose, 12.95 per cent sugar, 0.1 per cent acidity, 0.55 per cent ash, 4.49 pH, 1.058 specific gravity and 1.252 cp viscosity. The orange flavoured beverage contained 13.83 per cent total solid, 0.29 per cent protein, 4.99 per cent lactose, 12.90 per cent sugar, 0.33 per cent acidity, 0.54 per cent ash, 4.52 pH, 1.057 specific gravity and 1.252 cp viscosity.

Babar *et al.* (2008) studied that, the utilization of pomegranate juice for the preparation chakka whey beverage. They observed the mean value for chemical constituents of chakka whey were 0.226, 0.416, 4.514 and 0.422 per cent for fat, protein, lactose and ash, respectively.

Goyal and Gandhi (2009) studies on the comparative analysis of Indian paneer and cheese whey electrolyte whey drink. The paneer whey contain total protein 0.41 ± 0.07 per cent, 0.01 ± 0 per cent,

lactose 4.5 ± 0.89 per cent, total solids 5.8 ± 0.13 per cent and pH 5.5 ± 0.08, respectively.

Rupnar *et al.* (2009) studied on the sensory quality of paneer whey beverage prepared with kokum juice and they gave the chemical composition of paneer whey that was total solids 16.44 per cent, 19.75 per cent total sugar, protein 0.09 per cent, reducing sugar 4.66 per cent, 15.08 per cent non reducing sugar, acidity 0.41 per cent and pH 4.68, respectively.

Bhavsagar *et al.* (2010) studied that, the manufacture of pineapple flavoured beverage from channa whey. This beverage was prepared with the addition of 5, 10 and 15 per cent of pineapple pulp in channa whey. The pineapple flavoured channa whey beverage of treatments T_0, T_1, T_2 and T_3 contained fat 0.55, 0.51, 0.48, and 0.45 per cent, protein 0.57, 0.66, 0.73 and 12.57 per cent, ash 0.44, 0.60, 0.76 and 0.78 per cent, total solids 13.40, 13.89, 14.38 and 14.57 per cent, moisture 86.71, 86.20, 85.62 and 85.50 per cent, respectively. The observations in respect of pH for above treatment combinations were 3.91, 3.88, 3.86 and 3.89 and titratable acidity 0.59, 0.62, 0.63 and 0.62 per cent lactic acid, respectively.

Gaikwad (2010) studied on preparation of channa whey beverages using sapota pulp. The beverage was prepared by using 0, 5, 10 and 15 per cent of sapota pulp. They observed an average composition i.e. the moisture content of sapota whey beverage was found to be 93.50, 92.51, 91.52 and 90.50 per cent, fat 0.48, 0.51, 0.54 and 0.57 per cent, protein 0.38, 0.40, 0.41 and 0.42 per cent, ash 0.48, 0.51, 0.53 and 0.57 per cent, total solids 6.50, 7.49, 8.48, and 9.47 per cent and carbohydrate 5.16, 6.07, 7.00 and 7.91 per cent for treatments T_0, T_1, T_2 and T_3, respectively. He observed that as the proportion of sapota pulp increased, there was increased in fat, protein, ash, total solids and carbohydrate content of sapota whey beverage.

Sakhale *et al.* (2012) studied that, the development and storage of whey based RTS (Ready to serve) beverage from mango *cv. Kesar.* The whey and the juice of mango were utilized at various

combinations C_1 (70:30), C_2 (75:25), C_3 (80:20) in the preparation of beverage, respectively. They observed the TSS content in fresh RTS beverage was 15.7, 16.0 and 16.0 ^{0}Brix for beverage combinations C_1, C_2 and C_3, respectively. The acidity content was 0.36, 0.33 and 0.32 per cent for beverage combinations, respectively. The total sugar content was 11.09, 12.14 and 11.50 gm per cent for beverage combinations C_1, C_2 and C_3, respectively. The reducing sugar content was 3.40, 3.40 and 2.92 gm per cent for beverage combinations, respectively.

Bothe (2013) studied that, the preparation of whey based mango-herbal (lemongrass) beverage and reported that, the paneer whey from cow milk on an average contained 6.54 per cent total solids, 0.75 per cent fat, 0.46 per cent protein, 4.7 per cent lactose, 0.20 per cent acidity and pH 6.5.

Pareek *et al.* (2014) studied on preparation of healthy fruit based carbonated whey beverages using whey and orange juice and reported that, the results of nutrient analysis of most acceptable form of orange based carbonated whey beverage prepared by using orange juice 70 per cent and whey 30 per cent were total solids 8.7 per cent, pH 4.03, acidity 0.61 per cent, protein 1.1 per cent, total sugar 15.19 per cent, reducing sugar 11.25 per cent.

Jadhao (2016) studied on utilization of jamun juice in preparation of paneer whey beverage and found that the chemical composition of beverage prepared from 0, 5, 10, 15 and 20 per cent jamun juice were fat 0.51, 0.49, 0.48, 0.47 and 0.46, protein 0.42, 0.43, 0.44, 0.46 and 0.47, titratable acidity 0.28, 0.30, 0.35, 0.41 and 0.47, moisture 93.57, 92.90, 92.30, 91.69 and 91.07, total solids 6.43, 7.10, 7.70, 8.31 and 8.93, ash 0.60, 0.59, 0.58, 0.57 and 0.56, carbohydrate 5.09, 5.53, 6.00, 6.43 and 6.89 per cent, for treatments T_1, T_2, T_3, T_4 and T_5, respectively.

Mundphane (2016) studied on the preparation of channa whey beverage blended with watermelon (*Citrullus lanatus*) juice. The beverage was prepared by using 05, 10, 15, 20 and 25 per cent of watermelon juice in channa whey. They observed an average composition i.e. the moisture content of watermelon whey beverage were found to be

94.12, 93.90, 93.78, 93.64 and 93.57, fat 0.49, 0.47, 0.45, 0.43 and 0.42, pH 5.49, 5.47, 5.46, 5.43 and 5.41, protein 0.42, 0.44, 0.46, 0.48 and 0.50, total solids 5.88, 6.10, 6.22, 6.36 and 6.49, ash 0.43, 0.46, 0.49, 0.52 and 0.55, carbohydrate 5.14, 5.25, 5.44, 5.56, 5.68 and titratable acidity 0.26, 0.27, 0.28, 0.29 and 0.30 per cent for the treatments T_1, T_2, T_3, T_4 and T_5, respectively. He observed that as the proportion of watermelon juice increased, there was increased in protein, total solids, ash, carbohydrate and titratable acidity, while decreased in fat, moisture and pH.

2.3 Technology for whey beverage

Kamat *et al.* (1999) studied that, the paneer whey could be successfully utilized for preparation of nutritious and delicious soup by blending with tomato pulp at 25 per cent level and beet root pulp at 20 per cent level.

Hapse (2004) studies on chakka whey based beverage using mango pulp at 4, 6, 8 and 10 per cent and sugar 10, 12, 14 and 16 per cent and 0.25, 0.50, 0.75 and 1.00 per cent acidity levels. Out of this combination chakka whey blended with 14 per cent sugar having 0.75 per cent acidity and 10 per cent mango pulp was found most acceptable on sensory evaluation.

Patel *et al.* (2007) stated that, prepared whey-based mango herbal beverages. They utilized paneer whey for developing acceptable quality of beverages. They observed from the study at mango beverage that was found to be preferred most which contained 20 per cent mango pulp, 69.9 per cent paneer whey, 8 per cent cane sugar and 0.2 per cent ginger extract and was having a pH equal to 4.5.

Dhawale *et al.* (2009) studies that, channa whey beverage prepared using mango pulp by coagulating cow milk with citric acid the acidity of whey was kept constant at 70 per cent using citric acid for all 13 formulation. The maximum (8.5) flavour score was obtained to the product prepared from 5.0 per cent mango pulp and 7.5 per cent sugar.

Dhamsaniya and varshney (2013) studied on delicious and nutritious RTS beverage from the ripe banana juice and milk whey. The

proportion of banana juice, *Mentha arvensis* extract and milk whey varied from 5-15 ml, 1-5 ml and 72-86 ml per 100 ml of the prepared beverage, respectively. They found that an acceptable whey banana RTS beverage was prepared having 15 ml banana juice, 3 ml *Mentha arvensis* extract, 8 gm sugar powder and 77 ml milk whey per 100 ml of the prepared beverage, respectively. The developed RTS beverage was recommended for the large scale production at industrial level.

Manasi *et al.* (2013) develop a probiotic beverage using whey and pineapple juice. (*Lactobacillus acidophilus)* was used as the probiotic organism.

Sindhumati and premalatha (2013) conducted an experiment to study the feasibility of blending papaya and pineapple juice in combination with different naturally flavoured extract in 80:20, 70:30, 60:40 and 50:50 ratios. The extract of the flavouring agent was filtered and added in the ratio of 1:1 to the RTS beverage in varying proportions (2, 4 and 6 ml).

Bhatt and Singh (2014) studied on the development of beverage prepared from whey and guava pulp. Whey 67.5 per cent was heated at 45 per cent to dissolve sugar 12.2 per cent and citric acid 0.3 per cent. Guava pulp 20 per cent was thoroughly mixed with the above mixture and then finally added sodium alginate 1 per cent as stabilizer.

Damane *et al*. (2015) studied that, to reduce the spoilage and to increase the shelf life of the milk whey blended sugarcane juice using chemical preservatives. Milk whey, ginger juice and lemon juice were added at different proportion ranges 15-60, 0.5-0.7, and 2.5-3.0 per cent respectively in the 100 ml of the sugarcane juice.

Panghal *et al.* (2017) used dairy industry waste-whey in the formulation of papaya RTS beverage. The work was planned to prepare papaya based beverage with whey incorporation 0, 25, 50 and 100 per cent which is major environmental pollutant from dairy industry. RTS was evaluated for its nutritional composition, physico-chemical attributes like

titratable acidity, total soluble solids, total and reducing sugars and sensory quality. Microbial quality was also observed for 60 days.

2.4 Sensory evaluation of whey beverage

Pandey and Singh (2001) studied that, the preparation of carbonated soft beverage from chhana whey. Three levels of SNF (2.0, 2.5 and 3.0%), pH were examined using chhana whey. It was found that maximum mean value of sensory score (7.25) was recorded at 2.0 per cent SNF, 6.0 per cent sugar and pH 4.5.

Chauhan *et al.* (2002) reported that, sugarcane juice beverage samples were prepared by pasteurizing the sugarcane juice at 70 °C for 10 minutes and adding citric acid (40mg/100ml), ascorbic acid (40mg/100ml) and potassium metabisulphite (150ppm). Samples of sugarcane juice beverages were stored at room (30 ± 5°C) and refrigeration (4 ± 2°C) temperature in pre-sterilized glass bottles and analyzed for physico-chemical, micro-biological and sensory attribute at every fifteen days interval for 90 days.

Patel *et al.* (2007) studies the formulated whey based mango herbal ginger beverages in which contain 20 per cent mango pulp of different variety. The overall acceptability of *langra* variety was found best.

Babar *et al.* (2008) studied the utilization of pomegranate juice for the preparation of chakka whey beverage (CWB). In the preparation of beverages the volume of pomegranate juice 0 (T_1), 10 (T_2), 15 (T_3) and 20 (T_4) per cent with 10 per cent sugar was mixed in chakka whey. They observed that, the mean score of the product prepared for colour were 8.71, 8.62, 8.82 and 8.35, for flavour were 8.53, 8.70, 8.81 and 7.74, for consistency were 8.47, 8.65, 8.81 and 8.14 for treatments T_1, T_2, T_3 and T_4, respectively.

Bhavsagar *et al.* (2010) studied the manufacture of pineapple flavoured beverage from channa whey. This beverage was prepared with the addition of 5, 10 and 15 per cent of pineapple pulp in channa whey. The scores given for various parameters for the sensory evaluation were presented in following table.

Treatments	Colour	Consistency	Mouth Feel	Flavour	Overall acceptability
T_0	7.5	7.6	8.0	7.7	7.7
T_1	7.6	7.7	8.0	7.6	7.7
T_2	7.7	7.8	8.1	8.0	7.9
T_3	7.7	7.4	7.2	7.3	7.4

Shukla *et al.* (2013) develop a probiotic beverage using whey and pineapple juice by using *Lactobacillus acidophilus* as the probiotic organism. Whey and pineapple juice were blended in four different proportion i.e. 80:20, 75:25, 70:30 and 65:35 and evaluate for sensory attributes namely colour and appearance, consistency, flavour and overall acceptability were as 7.93, 7.81, 8.37 and 8.93 respectively.

Bhatt and Singh (2014) studied on preparation, quality evaluation and shelf life studies of whey-guava beverage. The ratio of whey and guava pulp that was used for the preparation of beverage is 67.5:20 (per cent). Then pasteurized at 60°C, 63°C, 65°C, 70°C for 15 minutes, 25 minutes, 35 minutes for treatments. Organoleptic evaluation showed that whey guava beverage prepared by using whey and guava pulp in the proportion of 67.5:20 (per cent) was found to be more compared to samples prepared by using different whey: guava concentrations, as it gave good colour, flavour, aroma, taste, mouth feel and overall acceptability.

Deepa and Krishnaprabha (2014) studies on development and nutrient, antioxidant and microbial analysis of muskmelon and whey water and probiotic incorporated squash. The muskmelon squash was standardized in different three variations V_1, V_2 and V_3 were prepared by adding 50 per cent, 40 per cent and 30 per cent whey water to 50 per cent, 60 per cent and 70 per cent muskmelon juice. The highest score for colour and appearance, flavour, consistency, taste and overall acceptability was given to the V_2 with 40 per cent addition of whey water and 60 per cent addition of muskmelon juice as 7.44 ± 0.86, 7.4 ± 1.04, 7.28 ± 1.02, 7.6 ± 0.912 and 7.6 ± 1.224, respectively.

Chavan *et al.* (2015) studied on the sensory evaluation of whey based mango beverage and reported that, the storability of the beverage was studied at 4 ± 1°C for 30 days. The storage study showed that, overall acceptability of the product showed a decrease in case of WMB while, it showed a non significant effect on other two samples. The overall acceptability of whey protein concentrate based mango beverage dry mix (WPCMB) was good after 30 days of storage at refrigeration temperature.

Jadhao (2016) studied on utilization of jamum juice in preparation of paneer whey beverage. In the preparation of whey beverage the volume of jamun juice 0 (T_1), 5 (T_2), 10 (T_3), 15 (T_4) and 20 (T_5) per cent with 10 per cent sugar was mixed in paneer whey. He observed that, the mean score of the product prepared for overall acceptability were 7.35, 7.84, 8.15, 8.76 and 7.90 for treatments T_1, T_2, T_3, T_4 and T_5, respectively. The treatment T_4 (8.76) scored significantly highest scores for flavour, colour, appearance, consistency and overall acceptability.

2.5 Cost of production of whey beverage

Kesarkar (2002) observed that, the cost of production of pineapple paneer whey per 250 ml bottles was Rs. 3.60

Ranade (2003) studied the chakka whey beverage blended with pineapple juice with the level 0, 15 and 20 per cent and sugar level 10, 15 and 20 per cent. The treatment containing 20 per cent pineapple juice and 20 per cent sugar was found best. Also he concluded that chakka whey beverage with 20 per cent pineapple juice and 20 per cent sugar can easily be prepared at home costing Rs. 20.32/litre.

Patel *et al.* (2007) reported that, the estimated cost of whey based mango herbal beverage. The production cost of the beverage was Rs. 4.53 for 250 ml.

Babar *et al.* (2008) studied the utilization of pomegranate juice for the preparation of chakka whey beverage (CWB). In the preparation of beverages the volume of pomegranate juice 0 (T_1), 10 (T_2), 15 (T_3), and 20 (T_4) per cent with 10 per cent sugar was mixed in chakka

whey. The cost of production of one litre chakka whey beverage under various treatments ranged from Rs. 4.44 (T_1) to 20.34 (T_4).

Rupnar *et al.* (2009) studied on sensory quality of paneer whey beverage prepared with kokam juice. And they gave the cost of production of top ranking three experimental samples *viz*., K_1S_2, K_1S_1 and K_2S_2 was Rs. 5.11, 4.72 and 5.57 per kg of final product.

Bhavsagar *et al.* (2010) studied the manufacture of pineapple flavoured beverage from channa whey. This beverage was prepared with addition of 5, 7, 10 and 15 per cent of pineapple pulp in channa whey beverage was Rs. 5.20 for pure channa whey beverage (T_0) for T_1, T_2, and T_3 were as Rs. 8.90, Rs.12.60 and Rs. 16.30, respectively.

Rohini *et al.* (2011) studied the cost of production of pineapple based channa whey beverage. The cost of production of channa whey beverage prepared by utilizing 20 per cent pineapple juice was Rs. 14.48 per litre.

Jadhao (2016) studied the manufacture of jamum juice flavoured beverage from paneer whey. This beverage was prepared with the addition of 0, 5, 10, 15 and 20 per cent of jamun juice in paneer whey. The cost of production of jamun juice flavoured paneer whey beverage was Rs. 11 for paneer whey beverage (T_1) whereas T_2, T_3, T_4, and T_5 were Rs. 13.45, Rs. 15.09, Rs. 18.35, Rs. 20.80, respectively.

Mundphane (2016) studied the preparation of channa whey beverage blended with watermelon (*Citrullus lanatus*) juice with the level of 5, 10, 15, 20 and 25 per cent and sugar of channa whey in all the treatments. The cost of production was Rs. 8.95, 13.30, 15.25, 17.20 and 19.12 /litre for treatments T_1, T_2, T_3, T_4 and T_5, respectively.

CHAPTER III

MATERIAL AND METHODS

The present investigation on “Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice” was undertaken during 2018-19 at the Department of Animal Husbandry and Dairy Science and Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. For this investigation the material used and methods employed were as below:

3.1 Materials

3.1.1 Collection of buffalo milk

Fresh, clean, whole buffalo milk was used for preparation of paneer whey beverage blended with sugarcane juice. For each trial buffalo milk was obtained from livestock Instructional Farm of Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola. Milk was strained through clean muslin cloth in stainless steel pot and used for the preparation of paneer and thereby to obtain whey.

3.1.2 Preparation of paneer whey

Good quality fresh buffalo milk was procured and then strained through muslin cloth. The milk was transferred to stainless steel vessel and brought to boil by heating. The vessel was then removed from the fire. The coagulant i.e. citric acid @ 2.0 per cent was added slowly and stirred to have uniform mixing. Then the mass was poured over stretched piece of clean muslin cloth over another vessel to drain of the whey with the help of paneer presser to remove excess whey from mass. The clear drained whey was collected in the vessel. The whey was again heated to a temperature of 100 °C for 5 minutes, so as to remove the traces of fat and curd particles. The yellowish green whey was then used for preparation of whey beverage. (De, Sukumar 1980)

3.1.3 Purchase of sugarcane juice

Fresh sugarcane juice was purchased from juice centre of local market and used for experimental purpose.

.3.1.4 Purchase of ginger and lemon

Fresh ginger and lemon was purchased from local market and juice was extracted and used for experimental purpose.

3.1.5 Chemicals

Analytical grade chemicals were used for chemical analysis of paneer whey beverage.

3.1.6 Mixer

Electrical mixer was used for preparation of ginger juice.

3.1.7 Sugar

Good quality sugar was used @ 5 per cent by volume of whey for the preparation of paneer whey beverage blended with sugarcane juice in each treatment.

3.1.8 Muslin cloth

Clean, suitable size muslin cloth piece was used for straining of whey.

3.1.9 Packaging material

Transparent glass bottles of 200 ml capacity were used and crown corked for airtight sealing and packaging of beverages. Both bottles and corks were sterilized before bottling using autoclave.

3.1.10 Equipment and accessories

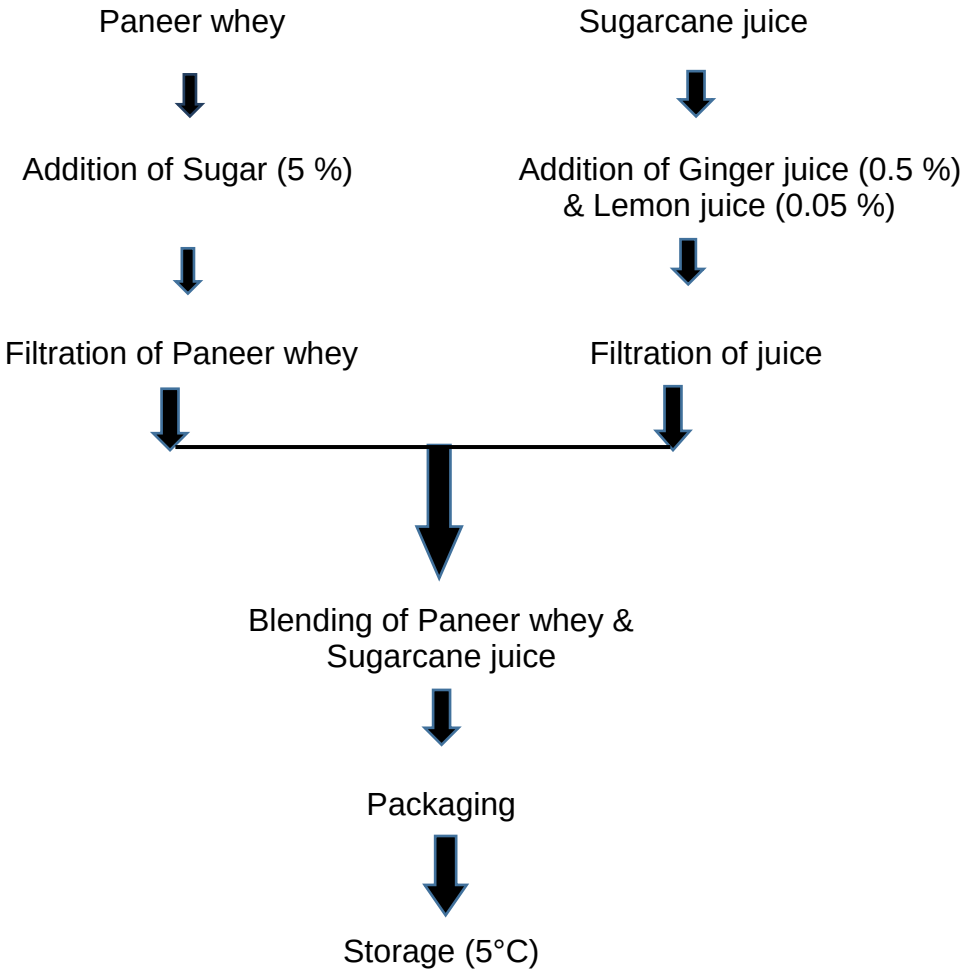
Stainless steel vessels of requisite capacity, knives, fruit extractor (mixer grinder), muslin cloth, standard weight balance, thermometer, gas stove, etc. were used for preparation of whey beverage with sugarcane juice. Before using this material it was properly cleaned and washed with detergent solution. All the precautionary measures were considered during the conduct of trial to avoid contamination.

3.2 Methods

3.2.1 Manufacture of paneer whey beverage by using sugarcane juice

Flow chart for whey beverage given by Damane *et al*. (2015) was used with following modifications. The paneer whey obtained from buffalo milk cool to room temperature. After getting this whey 5 per cent sugar was added in whey and sugarcane juice mixed as per treatments with lemon juice (0.05%) and ginger juice (0.5%).

3.2.2 Flow chart of paneer whey beverage by using sugarcane juice



3.3 Treatments Details

For the preparation of paneer whey beverage using sugarcane juice, the treatments combinations were as follows. Ginger juice (0.5 %) and Lemon juice (0.05 %) was used for preparation of paneer whey beverage and Sugar (5 %) was used by the proportion of paneer whey in all the treatments.

Draining of whey

Paneer whey

Blending of sugarcane juice

Paneer whey beverage with different levels of sugarcane juice

Plate. 1. Formulation of paneer whey beverage with different levels of sugarcane juice

Sample	Whey (%)	Sugarcane juice (%)
T_1	100	00
T_2	95	05
T_3	85	15
T_4	75	25
T_5	65	35

3.4 Quality assessment of paneer whey beverage (PWB)

3.4.1 Organoleptic evaluation of the product

The sample sugarcane based whey beverage were subjected to organoleptic evaluation on 9 point Hedonic scale as prescribed in IS:6273 (Part-II) 1971. A panel of six semi trained judges were provided the treated samples of the whey based sugarcane juice beverage for sensory evaluation.

3.5 Chemical analysis of paneer whey

3.5.1 Determination of Fat

Fat was estimated by Gerber method of fat estimation method as per IS: 1224 (Part-I), 1977, for that 10 ml of sulphuric acid was taken into butyrometer with the help of automatic tilt measure. 10.75 ml of paneer whey sample was taken with the help of pipette and transferred slowly into butyrometer. 1.0 ml of amyl alcohol was added in it by using automatic tilt measure. Stoppered the butyrometer with lock stopper using guiding pin and shaken the content well. Butyrometer was kept in water bath at 65°C for 5 min and placed the butyrometer in centrifugal machine for 5 min which revolved at 1100 rpm.

Butyrometer was taken out in upright position with the stopper end downwards. Reading of fat was taken directly taken from bottom of fat column to lower border of meniscus on the scale of butyrometer stem.

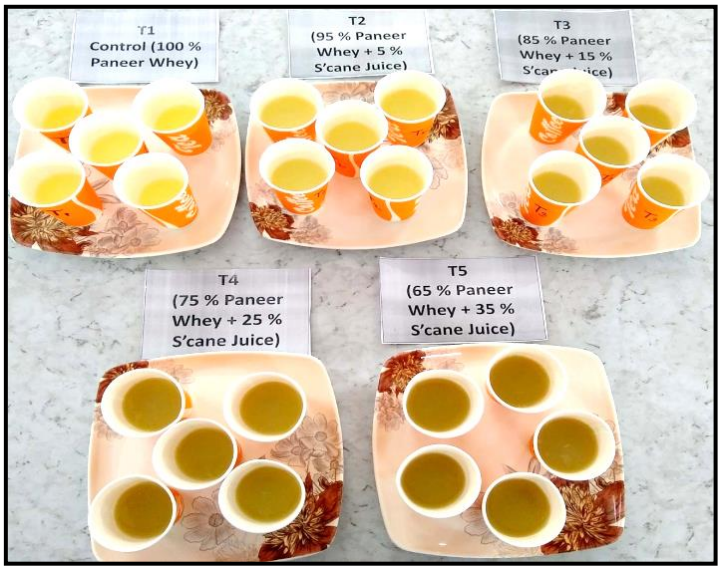


Plate 2. Review of research work by Student Advisory Committee

3.5.2 Determination of Protein

The protein content was determined as per Semi-Micro Kjeldahls method of Manfee and Overman described in A.O.A.C. (1965). For that two ml of whey sample was taken into a Kjeldahls flask. This was added with 25 ml of pure nitrogen free sulphuric acid 11.0 gm digestion mixture (10.0 gm of potassium sulphate + 1.0 gm of copper sulphate solid) was added, the content of the flask was digested by heating till it become colourless. The heating was continued for an hour or more. Then the content was cooled and diluted with 100 ml of distilled water.

The content of digestion flask were transferred to the distillation apparatus and made alkaline by adding 80 ml of 50 per cent NaOH solution in the presence of litmus paper. Small quantity of pumic stone powder was added to prevent bumping during distillation. 50 ml of 0.1 N H_2SO_4 was taken in a beaker and 3 drops of methyl red indicator was added to it. It was placed below the condenser tube so as to dip the condenser tube into the solution. It was disconnected when about 200 ml of distillate was collected in the beaker. Same was titrated against 0.1 N NaOH till the methyl red indicator changed from red to yellow i.e. natural.

$$\text{Nitrogen in sample (\%)} = \frac{\text{No. of ml of 0.1 N NaOH required} \times 0.0014}{\text{Weight of sample}} \times 100$$

The protein per cent was calculated by multiplying nitrogen percentage with factor 6.38.

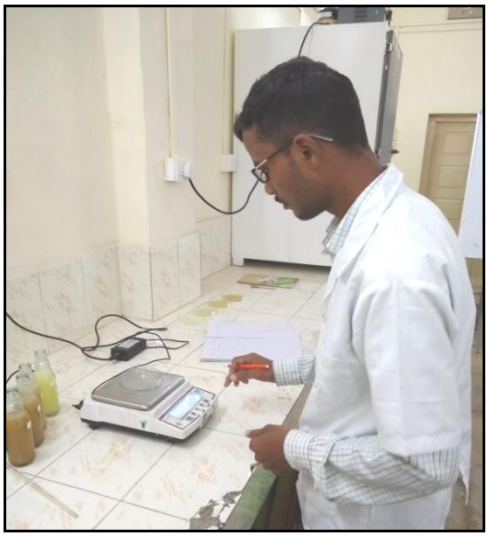
Protein (%) = Nitrogen in sample (%) × 6.38

3.5.3 Determination of Total Solids

The total solids was estimated as per method given in IS: 1479, (Part-II) 1961. A clean dry empty porcelain crucible or petri dish was kept in hot air oven maintained at 100°C for one and half hour cooled and weighted. Then 5 gm of paneer whey sample was added to the bottom and transferred to oven maintained at 100°C. After 2 to 3 hours crucibles or petri dish was immediately removed to desiccator to cool for about 30 min.

Determination of fat

Determination of protein



Determination of total solids

Plate.3. Analysis of sugarcane juice based paneer whey beverage for various physico-chemical parameters

Cont..

And weighted, the crucible or petri dish again returned to oven and heated for one more hour and then transferred to desiccator, cooled and weighted as before. This process was reported was repeated was till difference between successive weights did not exceed by 0.5 mg.

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

3.5.4 Determination of Titratable Acidity

Acidity of the paneer whey was determined as per the procedure described in ISI (SP-18 (Part XI) 1981, 10 ml of paneer whey sample was taken in porcelain dish, it was mixed with 10 ml of distilled water. Then two drops of phenolphthalein indicator was added and titrated against 0.1 N NaOH solution.

$$\text{Acidity (\%)} = \frac{\text{Number of ml of N/10 NaOH} \times 0.009}{\text{Weight of sample (specific gravity} \times \text{volume)}} \times 100$$

3.5.5 Determination of pH

The pH was estimated as per the procedure described in IS: 1479 (Part-II), 1961. The pH of paneer whey was measured by using digital pH meter at a temperature of 25 °C. Firstly the pH meter was standardized by using standard buffer solution of pH 4 and pH 9.2. The electrode of pH meter was directly dipped into the beverage and on the screen of pH meter, the pH of paneer whey was observed, which was recorded.

3.6 Chemical analysis of sugarcane juice

3.6.1 Determination of Fat

Fat was estimated by Gerber method of fat estimation method as per IS: 1224 (Part-I), 1977.

Determination of Acidity

Determination of pH

Plate.3. Analysis of sugarcane juice based paneer whey beverage for various physico-chemical parameters

3.6.2 Determination of Protein

The protein content was determined as per Semi-Micro Kjeldahls method of Manfee and Overman described in A.O.A.C. (1965).

3.6.3 Determination of Total Solids

The total solids was estimated as per method given in IS: 1479, (Part-II) 1961.

3.6.4 Determination of Titratable Acidity

Acidity of the paneer whey was determined as per the procedure described in ISI (SP-18 (Part XI) 1981.

3.6.5 Determination of pH

The pH was estimated as per the procedure described in IS: 1479 (Part-II), 1961.

3.7 Chemical analysis of paneer whey blended sugarcane juice

3.7.1 Determination of Fat

Fat was estimated by Gerber method of fat estimation method as per IS: 1224 (Part-I), 1977.

3.7.2 Determination of Protein

The protein content was determined as per Semi-Micro Kjeldahls method of Manfee and Overman described in A.O.A.C. (1965).

3.7.3 Determination of Total Solids

The total solids was estimated as per method given in IS: 1479, (Part-II) 1961.

3.7.4 Determination of Titratable Acidity

Acidity of the paneer whey was determined as per the procedure described in ISI (SP-18 (Part XI) 1981.

3.7.5 Determination of pH

The pH was estimated as per the procedure described in IS: 1479 (Part-II), 1961.

3.8 Cost of production of paneer whey beverage

The expenses on material use, labour charges and other expenditure at prevailing retail market rates during the experimental period. Cost of paneer whey was taken as Rs. 1.00 /lit. This cost was applied by the various research workers. The cost of sugarcane juice was Rs. 50 /lit. and the cost of sugar was Rs. 40/kg was taken an account while calculating cost of production on the lines of procedure used by Khamrui and Rajorhia, (1998).

3.9 Statistical analysis

Data obtained during the course of investigation were subjected to statistical analysis to test the effect of different levels of sugarcane juice, physico-chemical properties and sensory evaluation of the product analyzed by Randomized Block Design (RBD) as per the procedure given by Panse and Sukhatme (1985).

CHAPTER IV

RESULTS AND DISCUSSION

In the present investigation entitled as “Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice.” The major intention for undertaking this study is to utilize waste for best i.e. paneer whey for preparation of highly nutritious paneer whey beverage by blending it with different level of sugarcane juice. An attempt has been made in this investigation to evaluate for its physicochemical quality and cost of production. The results obtained have been discussed under following heads in the subsequent pages.

4.1 Chemical composition of paneer whey

4.2 Chemical composition of sugarcane juice

4.3 Sensory evaluation of paneer whey beverage prepared by blending with different levels of sugarcane juice

4.4 Chemical composition of paneer whey beverage prepared by blending with different levels of sugarcane juice

4.5 Cost of production of paneer whey beverage by blending with sugarcane juice

4.1 Chemical composition of paneer whey

The buffalo milk was used for production of panner whey and was procured from Livestock Instructional Farm of Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola and used for said research work. The data ascertain during present research work in relation to chemical composition of paneer whey is presented in Table 1.

A perusal of Table 1 revealed that, the average chemical composition of paneer whey utilized for whey beverage preparation contains fat 0.49 per cent, protein 0.41 per cent, total solids 6.93 per cent, acidity 0.21 per cent and pH 5.77.

Table 1. Chemical composition of paneer whey

Constituents	Content*
Fat (%)	0.49
Protein (%)	0.41
Total Solids (%)	6.93
Acidity (%)	0.21
pH	5.77

*Mean of four replications.

The composition of paneer whey presented and discussed above justifies with the study made by Goyal and Gandhi (2009). The chemical composition of buffalo paneer whey obtained during paneer making, having moisture 94.20 per cent, fat 0.52 per cent, protein 0.41 per cent, lactose 4.5 per cent, total solids 5.8 and pH 5.5.

The values for different paneer whey were within the normal range as reported by Saravankumar and Manimegalai (2002), reported that, paneer whey contained 7 per cent total solids, 0.1 per cent acidity, pH 5.2 and 5.2 per cent total sugar. The supportive observations also recorded by Paul (1990) and Rupnar *et al.* (2009).

4.2 Chemical composition of sugarcane juice

Fresh sugarcane juice was procured from local market from juice centre and used for further study. The chemical composition of sugarcane juice was evaluated as per the standard procedure and results were presented in Table 2.

Table 2. Chemical composition of sugarcane juice

Constituents	Content*
Fat (%)	0.08
Protein (%)	0.55
Total Solids (%)	20.87
Acidity (%)	0.56
pH	3.98

*Mean of four replications.

It is noticed from Table 2 that the sugarcane juice content was observed the various parameter as fat 0.08 per cent, protein 0.55 per cent, total solids 20.87 per cent, acidity 0.56 per cent and pH 3.98. These values were supportive to the results reported by Damane *et al.* (2015), reported that the raw sugarcane juice contained protein 0.56 percent, total soluble solids 18.5 per cent, acidity 0.40 per cent, moisture 81.67 per cent, ash 0.45 per cent and pH 3.80. Chauhan *et al*. (2002) reported the chemical composition of raw sugarcane juice, fat 0.19 per cent, protein 0.53 per cent, total soluble solids 19.50 per cent, moisture 80.00 per cent, ash 0.30 per cent, acidity 0.30 per cent and pH 5.50.

4.3 Sensory evaluation of paneer whey beverage prepared by blending with different levels of sugarcane juice

Sensory evaluation of any consumable product is an integral part of quality assurance programme. The word quality in relation to food is commonly the degree of excellence with respect to its palatability. In the process of food development, sensory evaluation has great importance and is a first step of product development. The acceptability of the whey beverage was measured in terms of sensory attributes such as flavour, colour and appearance, consistency and overall acceptability on 9 point Hedonic scale by a panel of six semi-trained judges. The mean value of sensory scores allotted by the judges for individual during sensory evaluation analysis are tabulated in Table 3 to 6 and graphically represented from Fig. 1 to 4.

4.3.1 Flavour

Flavour developed the desireness of taste and aroma to the product. Flavour is the major contributing attribute in the sensory evaluation of milk and milk products in general and fermented dairy products in particular. It provides half taste of product without eating. To know the flavour quality of paneer whey beverage with sugarcane juice prepared in this study were evaluated sensorily. Observations on flavour scores of paneer whey beverage are presented in Table 3 and illustrated graphically in Fig. 1

Table 3. Flavour Score of paneer whey beverage blended with different levels of sugarcane juice

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	7	6	5	7	6.25
T_2	7	6	7	8	7.00
T_3	7	8	8	8	7.75
T_4	9	9	8	9	8.75
T_5	9	8	9	8	8.50
'F' Test					Sig.
SE(M) ±					0.351
CD at 5%					1.092

It is revealed from the mean value of sensory scores of Table 3, the mean scores of flavour for fresh paneer whey beverage were 6.25, 7.00, 7.75, 8.75 and 8.50 for treatments T_1, T_2, T_3, T_4 and T_5, respectively. The different levels of sugarcane juice had significant ($P<0.05$) effect on flavour quality of paneer whey beverage. This indicates that the flavour of paneer whey beverage changed as the levels of sugarcane juice changes. The maximum scores were allotted to the treatment T_4 (8.75) whereas, the lowest treatment (6.25) was allotted for treatment T_1. Treatment T_4 was superior over T_1 and T_2, and at par with T_3 and T_5. Treatment T_4 (75 % paneer whey + 25 % sugarcane juice) showed maximum liking as compared to the rest of the treatments.

The effect of sugarcane juice inclusion with paneer whey on the flavour presented in Table 3 showed that paneer whey beverage with 25 per cent sugarcane juice scored highest for flavour on 9 point hedonic scale. It was found that the incorporation of sugarcane juice up to 25 per cent did not lower the mean scores for flavour was significantly ($P<0.05$). Further increase in the proportion of sugarcane juice lowered the sensory score. The blends consisting of 65, 75, 85 and 95 per cent whey proportion were like moderately to like extremely.

In addition to above majority the results were closely agreement with the past research workers observed the effect of fruit juice incorporation in whey. Shukla *et al.* (2013), Deepa and Krishnaprabha (2014) observed that the highest score for flavour was found to be more acceptable. These observations supported the present results on flavour of fruit juice incorporation to whey.

4.3.2 Colour and appearance

A colour is better judged by putting it against a white background. The data on colour and appearance scores of sugarcane juice based paneer whey beverage products are presented in Table 4 and illustrated graphically in Fig. 2, showed significant ($P<0.05$) differences in the values due to incorporation of different levels of sugarcane juice in beverage preparation.

Table 4. Colour and appearance score of paneer whey beverage blended with different levels of sugarcane juice

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	8	7	7	7	7.25
T_2	8	7	8	7	7.50
T_3	8	8	8	8	8.00
T_4	9	9	8	9	8.75
T_5	8	8	7	8	7.75
'F' Test					Sig.
SE(M) ±					0.219
CD at 5%					0.682

The mean scores of colour and appearance for fresh paneer whey beverage were 7.25, 7.50, 8.00, 8.75 and 7.75 for treatments T_1, T_2, T_3, T_4 and T_5, respectively. The highest score (8.75) was obtained for treatment T_4 while, the lowest score (7.25) was obtained for treatment T_1. Treatment T_4 was significant and superior followed by T_3, T_5, T_2 and T_1. Paneer whey beverage product prepared from (75 % paneer whey + 25 % sugarcane juice) T_4 was significantly appreciated.

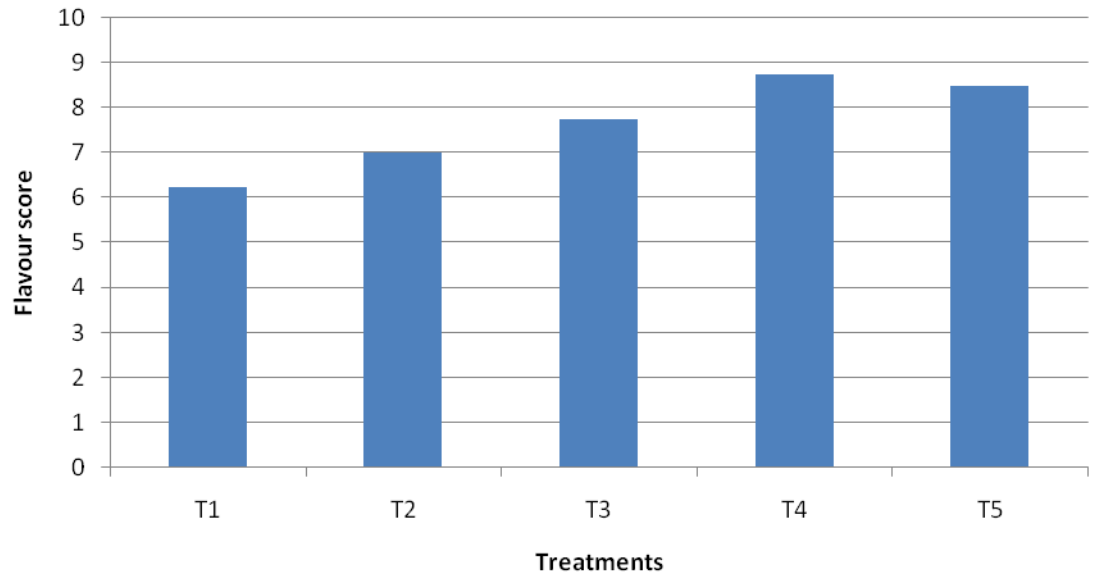


Fig.1. Effect of different levels of sugarcane juice on flavour score of paneer whey beverage

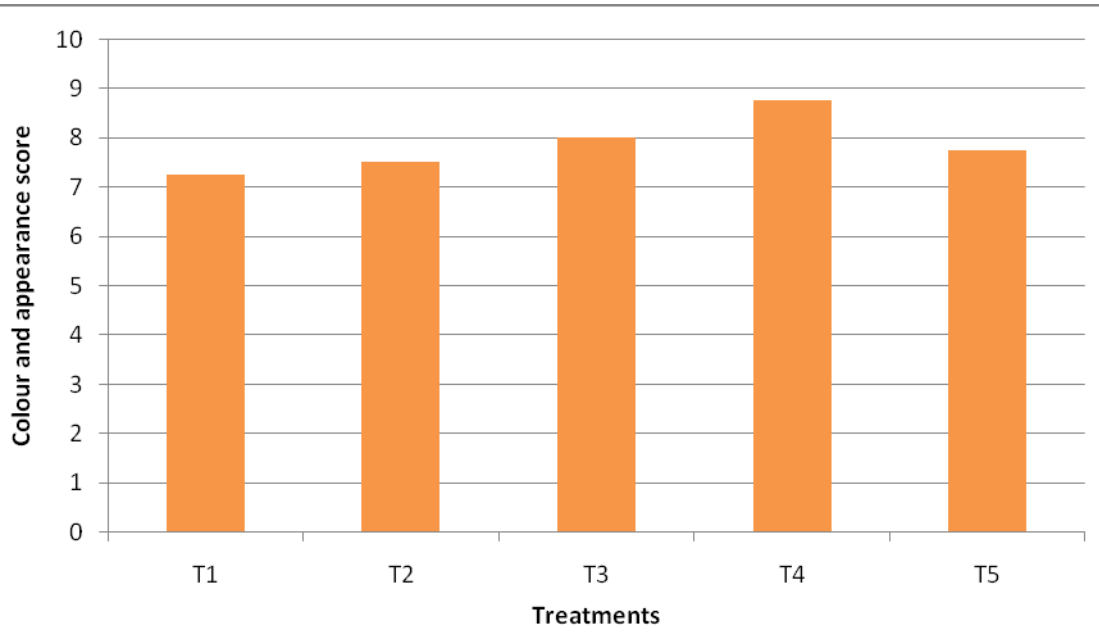


Fig.2. Effect of different levels of sugarcane juice on colour and appearance score of paneer whey beverage

It is seen from Table 4 that, the inclusion of sugarcane juice up to 25 per cent did not decrease the colour significantly (P<0.05) and thereafter the increased in levels of sugarcane juice lowered the value of colour.

It was experienced that incorporation of fruits and vegetables in the preparation of mango whey beverage Hapse (2004) and whey soup with vegetables Kamat *et al*. (1999) improved the colour and look by addition of 15 per cent beetroot pulp in whey beverage preparations, respectively. Present results were closely agreement with Babar *et al.* (2008) that, the average sensory score of chakka whey beverage for colour were 8.71, 8.65, 8.81 and 8.35 for treatments T_1, T_2, T_3 and T_4, respectively in chakka whey based pomegranate juice beverage. Bhavsagar *et al.* (2010) studied the manufacture of pineapple flavoured beverage from channa whey and found that the average score of pineapple flavoured beverage for colour were 7.5, 7.6, 7.7 and 7.7 for treatments T_0, T_1, T_2 and T_3, respectively in pineapple based channa whey beverage. The earlier work of these researchers is supportive to present investigation.

4.3.3 Consistency

The effect of different levels of sugarcane juice inclusion with paneer whey on the consistency of paneer whey beverage presented in Table 5 and represented graphically in Fig. 3, showed that, the (75 % paneer whey + 25 % sugarcane juice) (T_4) scored highest for consistency on 9 point Hedonic scale. It was found that the incorporation of sugarcane juice up to 25 per cent did not lower the mean score for consistency significantly (P<0.05). The increases in sugarcane juice levels significantly affect the sensory score for consistency.

Table 5. Consistency score of paneer whey beverage blended with different levels of sugarcane juice

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	7	6	7	7	6.75
T_2	7	8	7	7	7.25
T_3	8	9	7	8	8.00
T_4	9	8	8	9	8.50
T_5	8	8	9	8	8.25
'F' Test					Sig.
SE(M) ±					0.326
CD at 5%					1.016

The mean scores for consistency of whey beverage were 6.75, 7.25, 8.00, 8.50 and 8.25 under treatments T_1, T_2, T_3, T_4 and T_5, respectively. The highest score (8.50) was recorded in treatment T_4 while, the lowest score (6.75) was obtained by T_1 treatment. Treatment T_4 was significantly superior than T_1, and T_2, and at par with T_3 and T_5. The observations clearly indicate that, the highest liking was toward T_4. These results of consistency are closely agreement with the results reported by Babar *et al.* (2008) and Bhavsagar *et al.* (2010).

As far as consistency is concerned, the treatment T_4 beverage blends with 25 per cent of the sugarcane juice was acceptable by the panel of judges. This observation do support the present results on consistency of whey beverage prepared, and were recorded by different authors. Shukla *et al*. (2013) developed a probiotic beverage using whey and pineapple juice and *Lactobacillus acidophilus* as a cultural microorganism. They opined that the highest score for consistency was recorded by the beverage prepared with pineapple juice and whey (35:65).

Moreover, it is evident from Table 5, the different levels of sugarcane juice had significant ($P<0.05$) effect on consistency of paneer whey beverage product. This indicates that consistency of paneer whey

beverage product changed as the levels of sugarcane juice increases. Sample T_4 (75 % paneer whey + 25 % sugarcane juice) showed like extremely as compared to the rest of the treatments.

4.3.4 Overall acceptability

The overall acceptability is the consensus on the overall quality of the product. The samples of sugarcane juice based paneer whey beverage products prepared for the study were also subjected to record the scores of overall acceptability. The data pertaining to the scores of overall acceptability presented in Table 6, and Fig. 4, showed significant ($P<0.05$) variation due to addition of different levels of sugarcane juice.

Table 6. Overall acceptability score of paneer whey beverage blended with different levels of sugarcane juice

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	7.33	6.33	6.33	7.00	6.74
T_2	7.33	7.00	7.33	7.33	7.24
T_3	7.66	8.33	7.66	8.00	7.91
T_4	9.00	8.66	8.00	9.00	8.66
T_5	8.33	8.00	8.33	8.00	8.16
'F' Test					Sig.
SE(M) ±					0.171
CD at 5%					0.534

The mean scores for overall acceptability of fresh whey beverage were 6.74, 7.24, 7.91, 8.66 and 8.16 under treatments T_1, T_2, T_3, T_4 and T_5, respectively. The maximum scores were allotted to the sample T_4 (75 % paneer whey + 25 % sugarcane juice). This indicates that the good colour, peculiar flavour and proper consistency were observed in treatment T_4, also appreciated by the panel of judges.

Sugarcane juice based paneer whey beverage with treatment T_4 obtained highest score and significantly superior due to its flavour, colour and appearance and consistency as compared to other treatments.

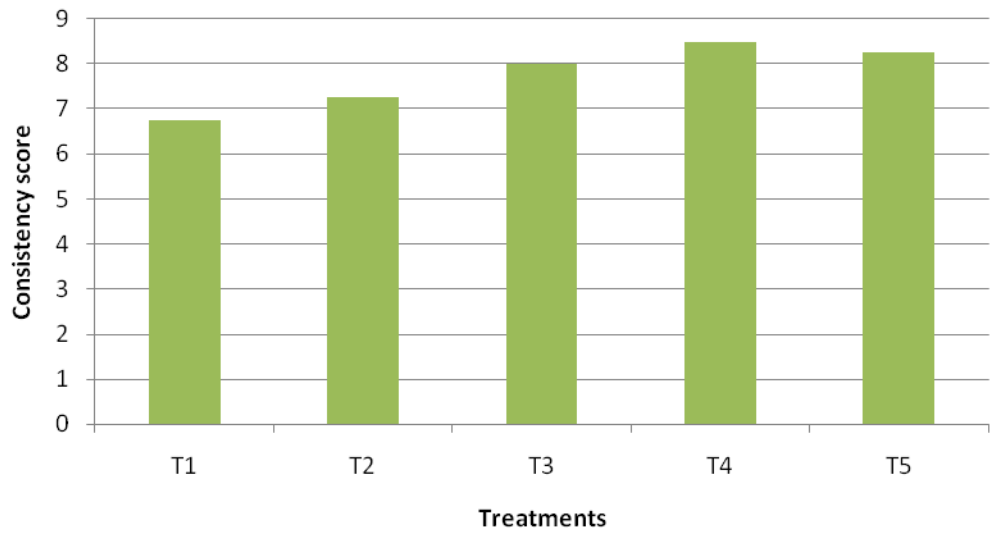


Fig.3. Effect of different levels of sugarcane juice on consistency score of paneer whey beverage

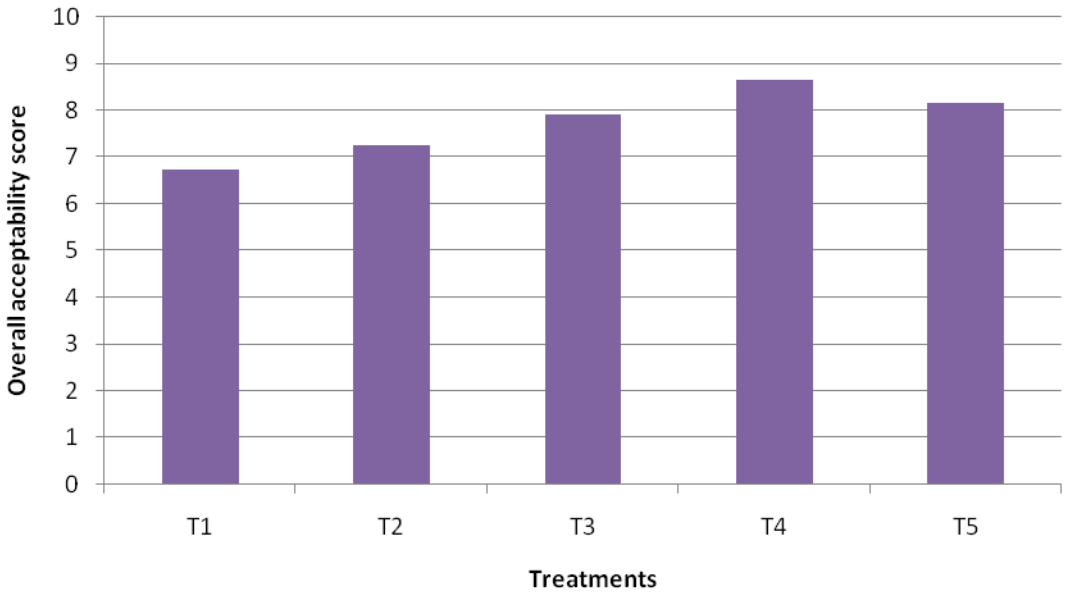


Fig.4. Effect of different levels of sugarcane juice on overall acceptability score of paneer whey beverage

The evidence from the literature indicates that, the variable treatments to the whey could produce refreshing and acceptable whey beverages. This finding get confirmed from the opinion of Sakhale *et al.* (2012) reported that a beverage prepared with 30 per cent mango juice and 70 per cent whey had highly acceptable taste and overall acceptability.

Statistical analysis of all the four attributes of sensory evaluation concluded that the incorporation of sugarcane juice in paneer whey to prepare sugarcane juice based paneer whey beverage up to 25 per cent proportion was found most suitable for acceptability.

4.4 Chemical composition of paneer whey beverage prepared by blending with different levels of sugarcane juice

The paneer whey beverages prepared by using different levels of sugarcane juice for this investigation were analyzed chemical composition and results are discussed here under. The results are tabulated in Table 7 to 11 and graphically depicted in Fig. 5 to 9.

4.4.1 Fat

The results related to the fat content of paneer whey beverage are presented in Table 7.

Table 7. Fat content of paneer whey beverage blended with different levels of sugarcane juice (%)

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	0.48	0.47	0.51	0.49	0.48
T_2	0.45	0.44	0.45	0.43	0.44
T_3	0.42	0.41	0.42	0.39	0.41
T_4	0.37	0.38	0.37	0.35	0.36
T_5	0.34	0.33	0.34	0.32	0.33
'F' Test					Sig.
SE(M) ±					0.005
CD at 5%					0.015

The results presented in Table 7, it was revealed that the significant ($P<0.05$) variation were noticed in the average value of fat content of the samples of sugarcane juice based paneer whey beverage products.

Fat content was determined higher (0.48%) in treatment T_1 whereas, treatment T_4 contained (0.36%) fat was acceptable in sensory evaluation.

The average values for fat content in paneer whey blended with sugarcane juice at 0, 5, 15, 25 and 35 per cent to prepare paneer whey beverage were obtained 0.48, 0.44, 0.41, 0.36 and 0.33 as treatments T_1, T_2, T_3, T_4 and T_5, respectively.

The fat content of paneer whey beverage was found significantly decreased with an increase the amount of sugarcane juice. The variation might be due to the lower amount of fat in sugarcane juice.

Above finding are supported to the percentage of fat content of whey beverages prepared and studied were recorded by different authors. The chemical composition of jamun juice based whey beverage by Jadhao (2016) and watermelon whey beverage by Mundhpane (2016) reported mean fat percentage were 0.51, 0.49, 0.48, 0.47, 0.46 and 0.49, 0.47, 0.45, 0.43, 0.42 for treatments T_1, T_2, T_3, T_4 and T_5, respectively.

4.4.2 Protein

The average values for protein content in paneer whey blended with sugarcane juice at 0, 5, 15, 25 and 35 per cent to prepare paneer whey beverage are presented in Table 8.

Table 8. Protein content of paneer whey beverage blended with different levels of sugarcane juice (%)

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	0.77	0.73	0.71	0.75	0.74
T_2	1.08	1.11	1.09	1.10	1.09
T_3	1.21	1.18	1.17	1.18	1.18
T_4	1.32	1.27	1.30	1.31	1.30
T_5	1.33	1.34	1.35	1.33	1.33
'F' Test					Sig.
SE(M) ±					0.009
CD at 5%					0.029

The average values for protein content in paneer whey beverage were obtained 0.74, 1.09, 1.18, 1.30 and 1.33 as treatments T_1, T_2, T_3, T_4 and T_5, respectively. The treatment T_4 was significantly superior by organoleptically evaluation.

The results presented in Table 8, it was revealed that, significant ($P<0.05$) variation was noticed in the average value of protein content in sugarcane juice based paneer whey beverage. The higher protein content determined in case of T_5 (1.33) as it was prepared by utilizing 35 per cent sugarcane juice and 65 per cent paneer whey. The protein content in blends was found proportionately increased with increases the level of sugarcane juice. The variation might be due to higher amount of protein per cent was found in sugarcane juice.

The trend of protein content in sugarcane juice based paneer whey beverage studied in this investigation varied, but comparable with the observations recorded by Shukla *et al*. (2004), Suresha and Jayprakasha (2004). Bhavsagar *et al*. (2010) by addition of 15 per cent pineapple pulp in whey beverage and Bhatt and Singh (2014) prepared whey guava beverage with incorporation of 20 per cent guava juice studied for different purpose.

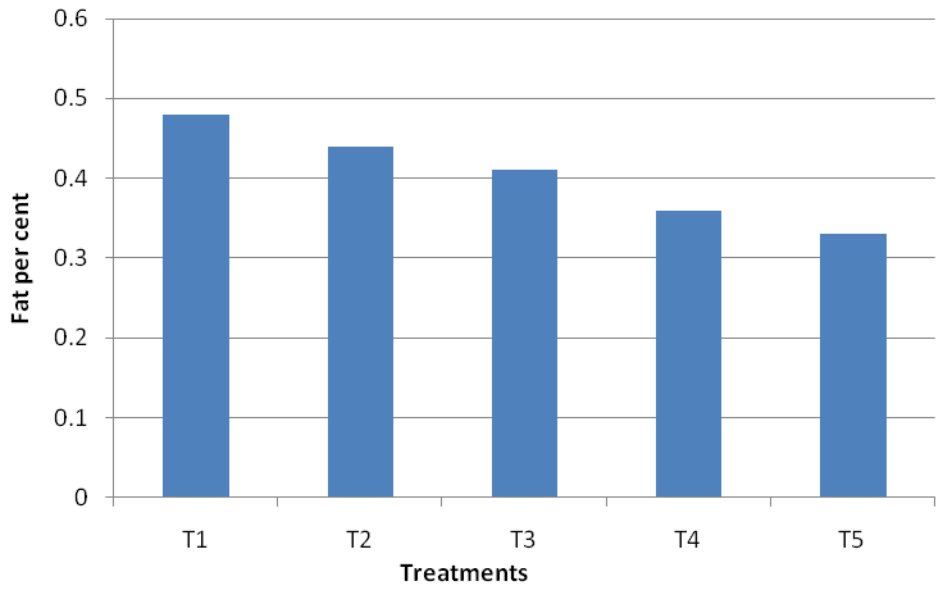


Fig.5. Effect of different levels of sugarcane juice on fat per cent of paneer whey beverage

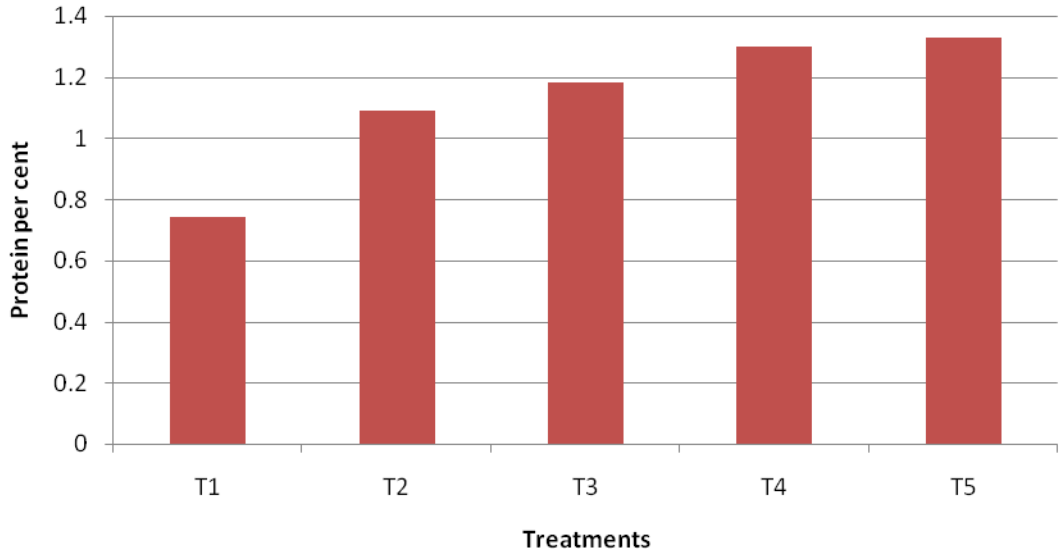


Fig.6. Effect of different levels of sugarcane juice on protein per cent of paneer whey beverage

4.4.3 Total Solids

The results related to the total solids content of paneer whey beverage are presented in Table 9.

Table 9. Total solids content of paneer whey beverage blended with different levels of sugarcane juice (%)

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	12.25	12.60	12.50	12.40	12.43
T_2	12.90	13.15	12.90	12.85	12.95
T_3	13.65	14.30	13.90	13.75	13.90
T_4	15.50	15.75	15.35	15.25	15.46
T_5	16.10	16.55	16.25	15.85	16.18
'F' Test					Sig.
SE(M) ±					0.059
CD at 5%					0.185

It was seen from results that the paneer whey with (35 %) sugarcane juice (T_5) contained higher total solids (16.18 %), followed by T_4 (15.46 %), T_3 (13.90 %), T_2 (12.95 %) and T_1 (12.43 %), which varied significantly ($P<0.05$). The organoleptically superior treatment T_4 contained 15.46 per cent total solids.

The past worker Kesarkar (2002) observed that the total solids in pineapple based whey beverage average 17.00 per cent in treatments were found similar trends with this result. Mundphane (2016) also observed the total solids in watermelon juice based whey beverage, were closely agreement with this results.

4.4.4 Acidity

It is revealed from Table 10 that, the observations on acidity content of paneer whey beverage showed that the average values for acidity content in paneer whey blended with sugarcane juice.

Table 10. Acidity content of paneer whey beverage blended with different levels of sugarcane juice (%)

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	0.42	0.41	0.40	0.42	0.41
T_2	0.43	0.44	0.44	0.45	0.44
T_3	0.46	0.47	0.47	0.48	0.47
T_4	0.49	0.50	0.49	0.49	0.49
T_5	0.51	0.52	0.54	0.52	0.52
'F' Test					Sig.
SE(M) ±					0.004
CD at 5%					0.014

The average values for acidity content in paneer whey beverage at 0, 5, 15, 25 and 35 per cent to prepare paneer whey beverage were 0.41, 0.44, 0.47, 0.49 and 0.52 per cent as treatments T_1, T_2, T_3, T_4 and T_5, respectively which, differences was observed significantly ($P<0.05$). The organoleptically superior treatment T_4 contained 0.49 per cent acidity.

The acidity of sugarcane juice based paneer whey beverage was in the range 0.41 to 0.52 per cent, which were considered to be at optimum level to relish any products/beverages. Significantly higher acidity (0.52%) was determined in treatment T_5. It indicates that significantly ($P<0.05$) variation was noticed in the average value of acidity content of sugarcane juice based paneer whey beverage product.

The acidity content of sugarcane juice blends beverage was found increased with increases the amount of sugarcane juice for the preparation of beverages. The acidity of beverage increases with addition of sugarcane juice in respective treatment with higher titratable acidity than paneer whey. Similar results were reported by Dhamsaniya and Varshney (2013) who found that the acidity of whey based Ready to Serve (RTS) beverage from ripe banana juice was increased 0.15 to 0.40 per cent with an increases with levels banana juice.

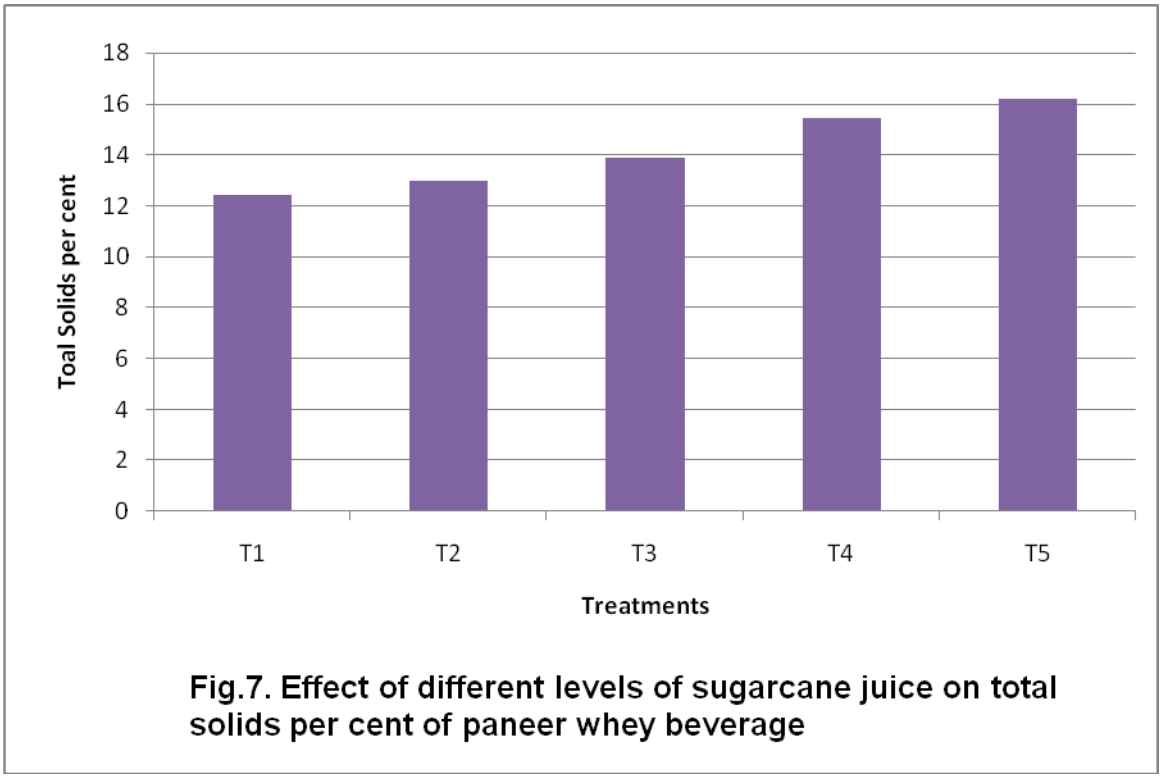


Fig.7. Effect of different levels of sugarcane juice on total solids per cent of paneer whey beverage

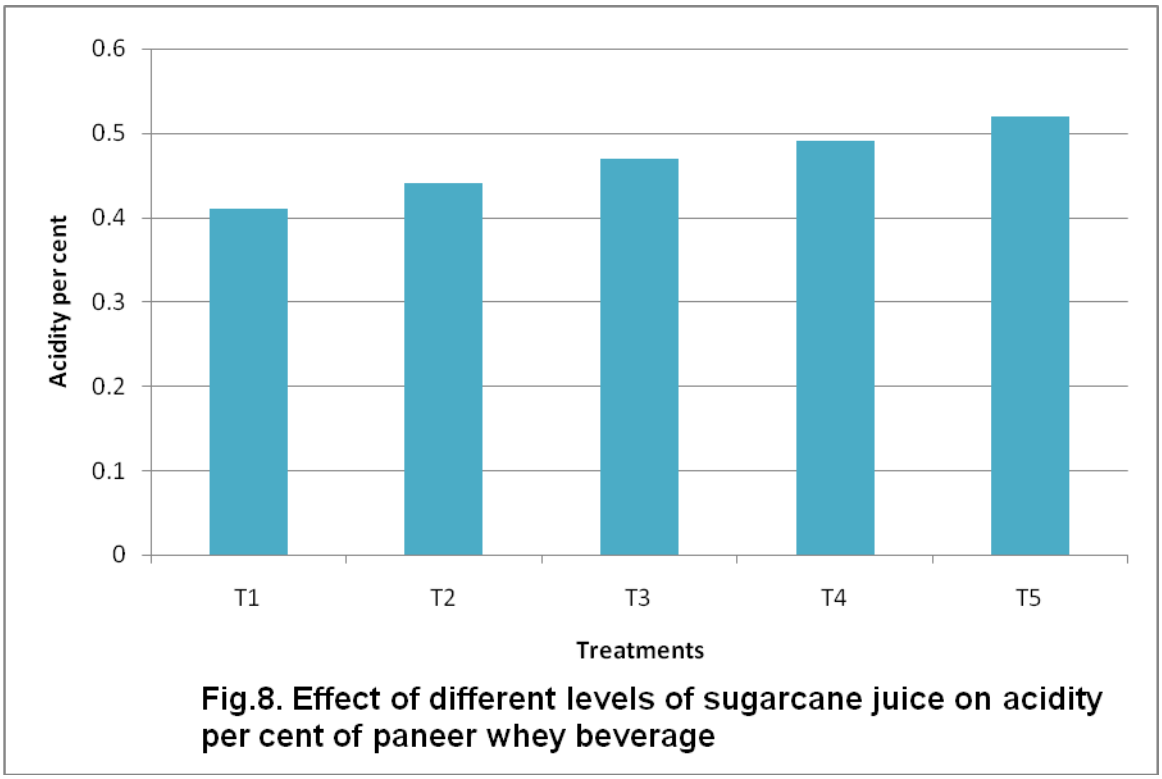


Fig.8. Effect of different levels of sugarcane juice on acidity per cent of paneer whey beverage

4.4.5 pH

The results on determination of pH in treatment samples of sugarcane juice based paneer whey beverage product were tabulated in Table 11.

Table 11. pH content of paneer whey beverage blended with different levels of sugarcane juice

Treatments	Replications				Mean
	RI	RII	RIII	RIV	
T_1	4.71	4.75	4.72	4.70	4.72
T_2	4.54	4.55	4.59	4.51	4.54
T_3	4.34	4.31	4.37	4.30	4.33
T_4	4.19	4.14	4.17	4.15	4.16
T_5	4.10	4.04	4.08	3.98	4.05
'F' Test					Sig.
SE(M) ±					0.013
CD at 5%					0.040

The average pH of paneer whey beverage by blending with different levels of sugarcane juice were 4.72, 4.54, 4.33, 4.16 and 4.05 for the treatments T_1, T_2, T_3, T_4 and T_5, respectively. Significant ($P<0.05$) variation was observed in the pH values.

The lowest pH value was observed in case of treatment T_5 (4.05). Moreover, the maximum pH was observed in treatment T_1 (4.72). In agreement to above, Pandey and Singh (2001) the pH of carbonated whey beverage was recorded 4.5. Whereas, Kesarkar (2002) recorded pH 4.47 in case of pineapple flavoured paneer whey beverage prepared with incorporation of pineapple pulp.

The pH decreased slightly and proportionately in the blends with increases in the amount of sugarcane juice. The decrease in pH is might be due to an increase in acidity there by decrease in pH.

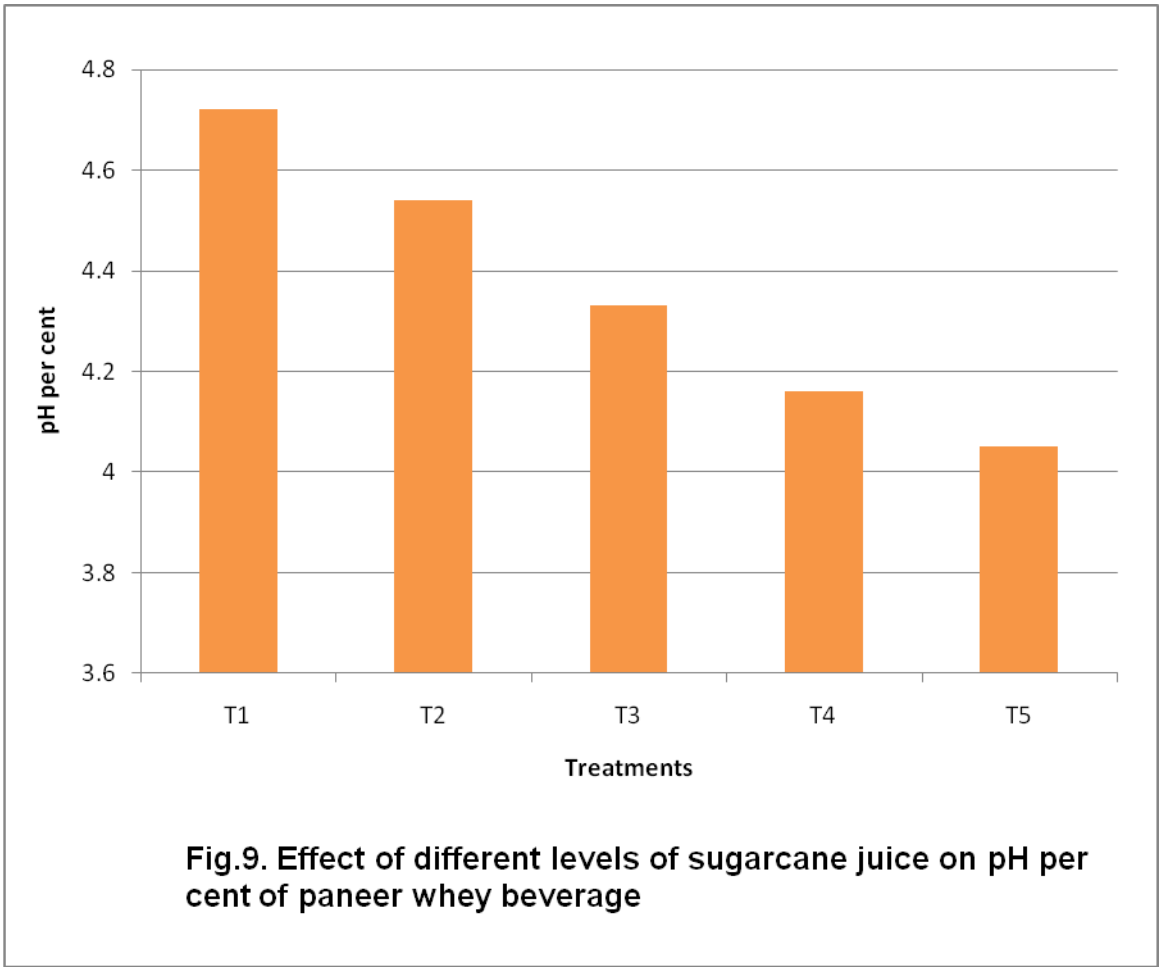


Fig.9. Effect of different levels of sugarcane juice on pH per cent of paneer whey beverage

Present finding are supported to the results obtained by Bhatt and Singh (2014) studied on preparation, quality evaluation and shelf life studies of whey-guava beverage. The ratio of whey and guava pulp was used for the preparation of beverage is 67.5:20 (per cent). They found that the pH of beverage varied from 3.93 to 3.87, respectively.

4.5 Cost of production of paneer whey beverage

In order to popularize this beverage, it is necessary that the product should be inexpensive as compared to other soft drinks available in the market. The cost of product was reduced under investigation; whey was utilized for product preparation. The whey is the waste disposal obtained during manufacture of coagulated dairy products. It contains valuable milk components, having high nutritional values. Data regarding on addition of sugarcane juice on the cost structure of paneer whey beverage prepared under various treatments are presented in Table 12 and graphically represented in Fig. 10.

The cost of production of one litre paneer whey beverage was calculated by taking into account the prevailing market rates of inputs used viz., paneer whey, sugarcane juice, sugar, lemon, ginger while the other charges such as fuel and labour etc. were worked out on the basis of actual hour of the work performed for the preparation of one litre paneer whey beverage. However, the depreciation cost of building, packaging and equipment's have not taken into consideration as the production was on laboratory scale. While, considering the prevailing rates of ingredients available in the local market and the rate of paneer whey as a byproduct during preparation of paneer, the cost is very less due to sale of major product paneer. Generally whey is not utilized in market for product preparation and it is just a waste during paneer preparation. So, whey was made available at only ₹ 1/lit. Thus, all the values were considered for calculating the cost of production of whey beverage.

Cost of items required for sugarcane juice based paneer whey beverage

Sr. No.	Particulars	Cost (₹)
1	Paneer whey	1.00/lit.
2	Sugar	40.00/kg
3	Sugarcane juice	50.00/lit.

From Table 12, revealed that, the cost of paneer whey beverage with different levels of sugarcane juice ranged between ₹ 7.50 to ₹ 23.95 per 1000 ml for treatment T_1 to T_5 respectively. The cost of treatment T_2, T_3, and T_4 were as 9.85, 14.55 and 19.25 per 1000 ml, respectively. The highest cost was recorded for treatment T_5 i.e. ₹ 23.95 for 35 per cent sugarcane juice was incorporated. The lowest cost was recorded for treatment T_1 i.e. ₹ 7.50. Increased level of sugarcane juice showed the increasing trend in cost of production of paneer whey beverage. The present investigation of whey beverage is comparable with those reported by Babar *et al.* (2008), Rupnar *et al.* (2009) and Rohini *et al.* (2011) as they reported the levels of fruit juice were increased the cost of production. These views are supportive to present results.

Table 12. Cost of production of paneer whey beverage prepared by blending with different levels of sugarcane juice. (Rs./lit.)

Sr. No.	Particulars	Treatment combinations									
		T1		T2		T3		T4		T5	
		Qty.(ml)	Amt. (₹)	Qty.(ml)	Amt. (₹)	Qty.(ml)	Amt. (₹)	Qty.(ml)	Amt. (₹)	Qty.(ml)	Amt. (₹)
1	Whey (1 ₹/lit.)	1000	1	950	0.95	850	0.85	750	0.75	650	0.65
2	Sugarcane Juice (50 ₹/lit.)	-	-	50	2.5	150	7.5	250	12.5	350	17.5
3	Sugar (gm) @ 5 % in whey (40 ₹/Kg)	50	02	47.5	1.9	42.5	1.7	37.5	1.5	32.5	1.3
4	Ginger Juice (0.5%)	5	2	5	2	5	2	5	2	5	2
5	Lemon Juice (0.05%)	0.5	0.50	0.5	0.50	0.5	0.50	0.5	0.50	0.5	0.50
6	Other (Fuel, Labour, Miscellaneous)	-	2	-	2	-	2	-	2	-	2
7	Total Cost (₹/lit.)	-	7.50	-	9.85	-	14.55	-	19.25	-	23.95
8	Cost/200 ml (₹/200 ml)	-	1.50	-	1.97	-	2.91	-	3.85	-	4.79

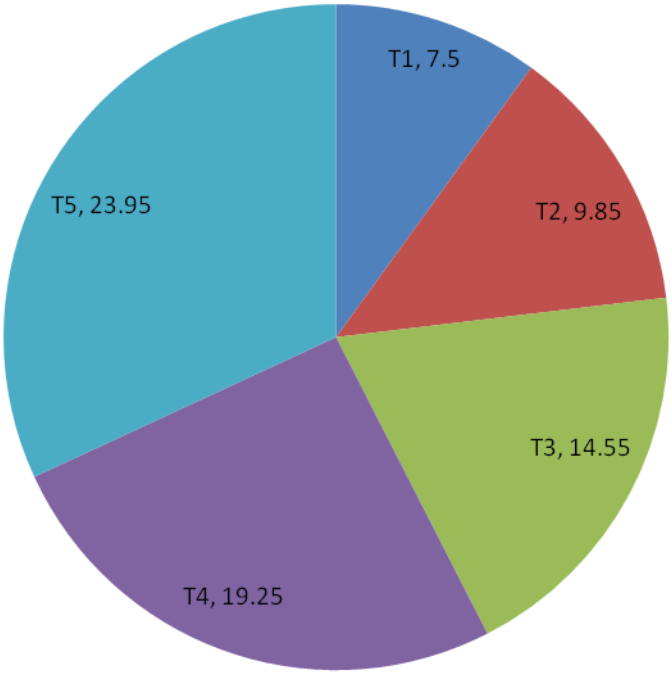


Fig. 10. Cost of production of paneer whey beverage prepared by blending with different levels of sugarcane juice.

The overall cost recorded for different blends was comparatively lower than market prices of different soft drink beverages. Further, it has better scope in future and may capture better popularity due to its ginger and lemon flavour content and being dairy based drink. The paneer whey can convert nutrient value into energetic and nutritional body building proteins beverage by using sugarcane juice at minimum cost.

The cost of production of paneer whey beverage for superior treatment, i.e. treatment T_4 with 25 percent blending of sugarcane juice in paneer whey was ₹ 19.25 per liter. Based on 200 ml beverage bottle, the cost of production of treatment T_4 was only ₹ 3.85, which seems to be very cheaper as compared to different soft drinks or beverage sold in market.

On an average the cost of sugarcane juice as ₹ 10 per 200 ml was considered for the calculation of cost of production. The cost of sugar ₹ 40.00 per kg, ginger and lemon both were ₹ 10 per 250 gm was taken for calculation, while other charges cost viz., labour, fuel and other miscellaneous was taken approximately.

In recent past, Ranade (2003) and Bhavsagar *et al.* (2010) determined the cost of production of pineapple chakka whey beverage were ₹ 20.32 and 12.60 /lit., respectively. The cost of production of sugarcane juice based paneer whey beverage (T_4) product was near about the cost recorded by authors mentioned above. The cost of production different beverages was found different.

CHAPTER V

SUMMARY AND CONCLUSIONS

The present investigation entitled “Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice” was undertaken at the Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. It was envisaged with the objective of utilizing paneer whey for developing highly nutritious paneer whey beverage by blending it with sugarcane juice. The effect of blending of paneer whey with sugarcane juice on physico-chemical characteristics and sensory scores of whey beverage and their blends were studied.

Fresh buffalo milk paneer whey and sugarcane juice was used for preparation of beverage through the period of investigation. Milk was heated to 80 – 85 °C for 5 min. and cooled to 72 °C. Citric acid solution was added in milk @ 2 per cent at 72 °C till the complete coagulation of milk and then whey filtered by using muslin cloth. Five types of whey beverages were formulated by adding 0, 5, 15, 25 and 35 per cent sugarcane juice added to paneer whey. Ginger juice (0.5 %), Lemon juice (0.05 %) and sugar was added @ 5 per cent by volume of paneer whey in the beverages which is same for all treatments. The product is filtered, filled in bottle, corked and stored at refrigerated temperature (up to 5^0 C).

The changes in physico-chemical and sensory were studied. The extensive studied were made in respect of change in flavour, colour and appearance, consistency and overall acceptability due to blending of paneer whey with sugarcane juice. Paneer whey beverage made from these blends was studied.

The data generated through this investigation was analyzed statistically, presented and discussed in detail. The summary of this presentation is as follows.

5.1 Chemical composition

5.1.1 Paneer whey

On an average paneer whey were contained 0.49, 0.41 and 6.93 per cent fat, protein and total solids respectively with acidity 0.21 per cent and pH 5.77 which was utilized for whey beverage preparation.

5.1.2 Sugarcane juice

The chemical composition of sugarcane juice was determined as fat 0.08 per cent, protein 0.55 per cent, total solids 20.87 per cent, acidity 0.56 per cent and pH 3.98 used as an ingredient.

5.2 Sensory evaluation of paneer whey beverage prepared with different levels of sugarcane juice

The sugarcane juice was blended with paneer whey in proportion of 0, 5, 15, 25 and 35 per cent. Sensory evaluation of the samples of sugarcane juice based paneer whey beverage products were carried out by using 9 point Hedonic scale with the panel of minimum six semi trained judges. Significant ($P<0.05$) differences in colour and appearance were noticed due to the treatments. The sample (T_4) prepared from 75 per cent paneer whey with 25 per cent sugarcane juice secured highest sensory score for flavour (8.75) followed by T_5 (8.50), T_3 (7.75), T_2 (7.00) and T_1 (6.25). All the samples had pleasant aroma but varying in degree.

The different levels of sugarcane juice had significant ($P<0.05$) effect on colour and appearance quality of products. Treatment T_4 secured highest sensory score (8.75) followed by T_3 (8.00), T_5 (7.75), T_2 (7.50) and T_1 (7.25). All the samples had pleasant aroma but varying in degree. The products appeared uniform, attractive and pleasant with pale yellow colour.

The mean scores, in respect of consistency of paneer whey beverage with different blends of sugarcane juice were 6.75, 7.25, 8.00, 8.50 and 8.25 for the treatments T_1, T_2, T_3 T_4 and T_5, respectively. However, Treatment T_4 scored maximum and ranked at the top.

Overall acceptability of the product influenced significantly ($P<0.05$) by different levels of sugarcane juice. The overall acceptability score

of sample T_4 was at higher side (8.66) of all treatments whereas, the treatment T_1 scored the least (6.74). Further, it was revealed that the treatment T_2 (7.24), T_3 (7.91), T_4 (8.66) and T_5 (8.16) shown good overall acceptability than treatment T_1 (6.74).

5.3 Chemical composition of paneer whey beverage prepared with different levels of sugarcane juice

Treatment wise fat content recorded as T_1 (0.48), T_2 (0.44), T_3 (0.41), T_4 (0.36) and T_5 (0.33) per cent, differed significantly ($P<0.05$). Treatment T_1 had significantly higher fat than the rest of the treatments.

The protein content determined was 0.74, 1.09, 1.18, 1.30 and 1.33 per cent for treatments T_1, T_2, T_3, T_4 and T_5, respectively. Treatment T_5 had significantly higher protein over rest of the treatments.

The total solids content in sugarcane juice based paneer whey beverage products in treatments T_1, T_2, T_3, T_4 and T_5 were as 12.43, 12.95, 13.90, 15.46 and 16.18 per cent, respectively. The effect of sugarcane on total solids content of beverage was statistically significant ($P<0.05$).

Treatment wise acidity content of paneer whey beverage with different blends of sugarcane juice product were 0.41, 0.44, 0.47, 0.49 and 0.52 per cent in treatments T_1, T_2, T_3, T_4 and T_5, respectively. The values differed significantly ($P<0.05$).

The average values of pH in paneer whey beverage with different blends of sugarcane juice product determined were 4.72, 4.54, 4.33, 4.16 and 4.05 in treatments T_1, T_2, T_3, T_4 and T_5, respectively which differed significantly ($P<0.05$).

5.4 Cost of Production

The manufacturing cost of sugarcane juice based paneer whey beverage product calculated on the basis of prevailing market rates of ingredients, was laid in the range of ₹ 7.50 to ₹ 23.95 /lit. Increased level of sugarcane juice showed the increasing trend in cost of production of paneer whey beverage. The cost of production sensorily best treatment (T_4) was ₹ 19.25 /lit.

Based on 200 ml beverage bottle, the cost of production of treatment T_4 was only ₹ 3.85 which seems to be very cheaper as compared to different soft drinks or beverages sold in market.

Conclusions

From the results of present investigation following conclusion were emerged:

1. Paneer whey a by-product generated during manufacturing of paneer can be efficiently utilized for the preparation of paneer whey beverage products.
2. The incorporation of sugarcane juice in blends of paneer whey up to 25 per cent proportion was found acceptable and more suitable without affecting the sensory characteristics significantly.
3. The blending of sugarcane juice enhanced the level of protein, total solids, acidity and decreased the level of fat and pH. The variation in proximate compositional constitute was proportional and significant.
4. The running cost of sugarcane juice based paneer whey beverage product calculated as ₹ 7.50 to ₹ 23.95 /lit. Product was found to be economically feasible as compared to other popular beverage as per market price survey.
5. Fresh sugarcane juice utilization up to 25 per cent in paneer whey produce good quality value added beverage. This will protect the interest of dairy industries with best utilization of whey; otherwise it would be a waste.

CHAPTER VI

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APPENDIX- I

SCORE CARD
FOR SENSORY EVALUATION OF SUGARCANE JUICE BASED PANEER WHEY BEVERAGE

Date:

Trial No.:

Name of Evaluator:

Treatment	Flavour (9)	Colour and Appearance (9)	Consistency (9)	Overall acceptability (9)
T_1				
T_2				
T_3				
T_4				
T_5				

Remark: Signature

The numerical values of the score card as under (9-point Hedonic Scale).

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

APPENDIX- II

Average rates of different juices available in market

Sr. No.	Particulars	Name of Product	Quantity (ml)	Average Rates (Rs.)
1.	Local Fruit Juice Sellers	Sugarcane juice	200 ml	10/-
		Orange juice	200 ml	20/-
		Pomegranate juice	200 ml	25/-
		Mixed fruit juice	200 ml	20/-
		Pineapple juice	200 ml	25/-