PREPARATION OF FLAVOURED PANEER

THESIS

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

By

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DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled **"PREPARATION OF FLAVOURED PANEER"** or part there of has neither been submitted for any other degree or diploma of any university, nor the data have been derived from any thesis / publication of any university or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place: Akola (GOLE ROSHANI RAMCHANDRA)

Date: / /2019 Enrolment No.PP-3309

CERTIFICATE

This is to certify that the thesis entitled **"PREPARATION OF FLAVOURED PANEER"** submitted in partial fulfilment of the requirements for the degree of "**Master of science in Agriculture** in the discipline **Dairy Science,** Department of **Animal Husbandry and Dairy Science"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **GOLE ROSHANI RAMCHANDRA** under my guidance and supervision.

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

Place : Akola

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%	:	Per cent
/	:	Per
°C	:	Degree Celsius
°B	:	degree brix
@	:	At the rate of
>	:	Greater than
BIS	:	Bureau of Indian Standard
CD.	:	Critical difference
Cfu	:	Colony forming unit
et al.	:	et alia (and others)
etc.	:	et cetera (and other things)
FFA	:	Free Fatty Acids
FDM	:	Fat on dry matter
Fig.	:	Figure
gm	:	Gram
HDPE	:	High Density Polyethylene
Hr.	:	Hour
i.e.	:	that is
IS	:	Indian Standard
Kg	:	Kilogram
Mm	:	Milimeter
ppm	:	Parts Per Million
Rs	:	Rupees
S.E.	:	Standard error
SNF	:	Solid not fat
SSHE	:	Scrapped surface heat exchanger
T.S.	:	Total Solids
viz.,	:	Namely
w/v	:	Weight by volume
WPM	:	Whole Milk Powder
WPC	:	Whey Protein Concentrate

(E) THESIS ABSTRACT

a)	**Title of the thesis**	**:**	**"PREPARATION OF FLAVOURED PANEER"**
b)	**Name of the student**	**:**	**GOLE ROSHANI RAMCHANDRA**
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ABSTRACT

The present investigation entitled 'Preparation of flavoured paneer' was undertaking in Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola with a view to

utilize valuable, nutritious, cumin and black pepper powder and their combinations with buffalo milk for preparation of paneer.

The main objective of present investigation were to find out acceptable level of spices, to study sensory quality, to study the physico-chemical properties, and to work out the production cost of paneer prepared from addition of cumin, black pepper powder and their combination in buffalo milk. Some of the silent findings emerged from the present investigation as summarized as follows.

The buffalo milk used for preparation of flavoured paneer contained 84.2 per cent moisture, 6.6 per cent fat, 3.82 per cent protein, 5.2 per cent lactose, 0.83 per cent ash, and 15.8 per cent total solid. While in cumin 8, 22, 18 and 8 percent water, fat, protein and ash respectively in 100 gm of seeds and black pepper contain 8.0 percent water,10.2 percent fat,10.0 percent protein and 4.6 percent ash in 100 gm of black pepper

The paneer was prepared from buffalo milk with addition of cumin, black pepper powder and their combination at the rate of 0% cumin, black pepper and there combination in T_1. 0.2% and 0.4% cumin powder in T_2 and T_3 respectively. Black pepper powder at the rate of 0.2% and 0.4% in T_4 and T_5 respectively. Also in T_6 combination of cumin and black pepper powder at the rate of 0.2% each and in T_7 combination of cumin and black pepper powder at the rate of 0.4% each.

Cumin and black pepper powder with 0.2 to 0.4 per cent level individually and in combination also was used as blending with buffalo milk for preparation of paneer, significantly affect the moisture, ash content of paneer. Protein, fat, and total solid content increased significantly as cumin and black pepper powder proportion increased individually and in their combination also from 0.2 to 0.4 per cent.

The overall acceptability of paneer prepared from buffalo milk was acceptable in all respect but with addition of cumin and black pepper powder in their combinations in proportion of 0.4 percent (T_7) each was good quality and acceptable for value addition. Also 0.4 percent black

pepper powder (T_5) and 0.4 percent cumin powder (T_4) were also acceptable in quality and for value addition also.

Regarding cost of production of paneer it was observed that the cost of production increased considerably due to blending of cumin and black pepper powder with buffalo milk for preparation of paneer which can be compensated with flavour.

It can be concluded that blending of cumin and black pepper powder in combination also individually was useful for manufacture of paneer having more acceptable quality.

CHAPTER I

INTRODUCTION

1.1 Background Information

Milk has been recognised as a complete food by nutritionists all over the world. It has all the ingredients and nutrients necessary for growth and maintenance of a healthy human body. Modern science as well as ancient Indian texts and scriptures are full of references eulogizing the virtues of milk as a complete food. Indian scripture have been described milk as the elixir of life or Amrita.

Milk is considered to be divine, holy and a symbol of purity. In ancient times a country was said to be prosperous based on its cattle population and milk production. With domestication of animals, bovine milk forever became a source of human food since ancient civilization. Cow milk was first used as food in the Middle East regions and since the milk of various animals assumed enormous significance in day-to-day lives of humans. Its use is intricately linked to the good health of body as well as soul. “Land of milk and honey” was always symbol of richness and prosperity so much so that availability of milk and milk products in a house was an indicator of its flourishing prosperity.

India contributes about 18-20 per cent of world’s total milk production. Out of which, buffalo milk contributes 55 per cent and cow milk 40.5 per cent of total milk production. Hence, there is a good potential and availability of milk for the preparation of milk products in India. About 47 per cent of milk produced in India is converted into paneer, dahi, chhana, khoa, etc. (FAO, 2001). India's export of dairy products was 39,397.62 metric tonne (MT) worth of Rs. 910.44 Crores / 136.06 united states dollar (USD) Millions during the year 2016-17 (Anonymous, 2017).

India has progressed from being deficient in milk production at 20 million MT in 1970 to becoming the world’s largest milk producer at 160 million MT, accounting for 18.5% of global milk production. India’s milk production increased from 165.40 million metric tonnes (MMT) in 2016-17

to 176.35 MMT in 2017-18, a growth rate of 6.62 per cent (NDDB, 2019). World is growing at the rate of around 1.8%.Out of 1.8% growth,1% is coming from India. Milk is India's largest crop worth around Rs.6.5 lakh crore it is much more than paddy and wheat put together. Till the 1970s, per capita consumption was only 110 gram per person per day. Today, per capita availability of milk in India during 2017-18 was 375 gm/day (NDDB, 2019)

Milk and milk products represent an excellent source of nutrients. They provide high quality proteins in addition to energy, minerals, and fat-soluble and water-soluble vitamins. Thus, milk and milk products constitute an integral component of human diet in most parts of the world. Milk contains several extra-nutritional constituents such as conjugated linoleic acid, spingomylins, butyric acid, myristic acid and β-carotenes, which protect against cancer, cardiovascular diseases, enteric infection and diabetes. There is no scientific base for implicating milk in cardiovascular diseases, diabetes, cancer etc; all such concerns are unfounded (Kansal, 2004).

Paneer is an important nutritious and wholesome indigenous dairy product, which occupy a prominent place among traditional milk products and carry lot of market potential. It is non-fermentative, non-renneted, non-melting and unripened type of cheese. It is an estimated that about 5 per cent of milk produced in India is converted to paneer (ICMR, 2000; Chandan, 2007); production figure being 3,959 metric tonnes in the year 2002–03, which increased to 4,496 metric tonnes in the year 2003–04 (Joshi, 2007; Shrivastava and Goyal, 2007) exhibiting a growth of 13 per cent. This indicates that there is tremendous opportunity for manufacturing and marketing of paneer.

Paneer is a South Asian variety of soft cheese prepared by acid and heat coagulation of milk. According to the PFA (2010), paneer means product obtained from cow or buffalo milk or combination thereof, by precipitation with sour milk, lactic acid, or citric acid. It shall contain not more than 70 per cent moisture and the fat content should not be less than 50 per cent expressed on dry matter. Bureau of Indian Standards (BIS

1983) imposed maximum of 60 per cent moisture and minimum of 50 per cent fat in dry matter for paneer. Good quality paneer is characterized by a marble white colour, sweetish, mildly acidic taste, nutty flavour, spongy body and closely knit, smooth texture. The ability of paneer to be deep fried is one feature that has led to its wider acceptance and a favourite for making snacks, pakoras or fried paneer chunks (Aneja, 2007).

Paneer is of great value in diet, especially in the Indian vegetarian context, because it contains a fairly high level of fat and proteins as well as some minerals, especially calcium and phosphorous. It is also good source of fat soluble vitamins A and D. Paneer is a rich source of animal protein available at a comparatively lower cost and forms an important source of animal protein for vegetarians. Over and above its high protein content and digestibility, the biological value of protein in paneer is in the range of 80 to 86 (Shrivastava and Goyal, 2007). So its food and nutritive value is fairly high. Superior nutritive value of paneer is attributed to the presence of whey proteins that are rich source of essential amino acids. Due to its high nutritive value, paneer is an ideal food for the expectant mothers, infants, growing children, adolescents and adults. Paneer is also recommended by the clinicians for diabetic and coronary heart disease patients (Chopra and Mamtani, 1995).

Recently herbal products either in the form of cosmetics or food has become more popular in the world market. Epidemiological data as well as in vitro studies strongly suggest that food containing phyto-chemical with anti-oxidation potential have strong protective effect against major disease risks including cancer and cardiovascular disease (Kaur and Kapoor, 2002).

Herbal sweet preparation is a new concept in dairy industry. Herbal sweets are the sweets that are prepared with the herbs that have been used as a food and medicinal purpose for centuries. Recently there has been an increasing trend to fortify the product with fruit or spice pulp/juice. Spices are considered as a good source of minerals with medicinal property.

Cumin (*Cuminum cyminum L.*) is a small annual herbaceous plant that is a member of the aromatic plant family *Umbelliferae*. Cumin is cultivated in India, Morocco, Iran, Turkey, China and the America. The seeds of the plant are used to add flavour to spicy dishes. They are also used as an appetite stimulant and to ease stomach disorders. A powder suspension of the cumin inhibits mycelium growth, toxin production or aflatoxin production by *Aspergillus ochraceus*, *Candida versicolor* and *Candida flavus*. The antibacterial action has also been seen against a range of useful and pathogenic gram-positive and gram-negative bacterial strains. Mainly cuminaldehyde, carvone, limonene and linalool and to a certain extent limnonene, eugenol, pinene, etc. contributes to the antimicrobial activity of cumin. The fatty oil (mainly petroselic acid) present in cumin exerts antimicrobial effect too. Antifungal activity of cumin is recorded against food, human pathogens, including dermatophytes, vibrio spp., yeasts, aflatoxins and mycotoxin producers. The Minimum Inhibitory Concentration (MIC) values for cumin essential oil ranged from 6.25 to 12.5%. (Oraon et al. 2017)

In Sanskrit, Cumin is known as jiraka. Jira means “that which helps digestion”. Ayurveda considers jiraka as one of the best digestive tonics. Some of the Ayurvedic health benefits of cumin are that it dispels gas, eliminates toxins, is a mild laxative, and is anti-inflammatory. Because it’s so easily digested and so effective in expelling gas from the stomach and the intestines, it’s used for chronic dysentery and diarrhea. Cumin kindles the gastric fire or the agni and improves the absorption of minerals in the intestines.

Black pepper, known as the King of Spices, is the most important and most widely used spice in the world. The black pepper of commerce is the dried mature fruits (commonly called berries) of the tropical, perennial climbing plant (*Piper nigrum* L.), which belongs to family Piperaceae. Black pepper is a woody climber, grown in the South Western region of India, comprising of the states of Kerala,(entire region once known as Malabar)

Black pepper, christened the ‘King of Spices’ and ‘black gold’, is the most important and most widely used spice in the world, occupying a position that is supreme and unique. This spice with its characteristics pungency and flavour is an ingredient in many food preparations, and at the dining table it is the only spice invariably served. Black pepper have a strong pungent flavour that comes from volatile oils, such as piperine It was used for different purposes by different people in the past, and continue to be so currently and will remain so in future as well. Now for the common Indians Black pepper is a spice as well as medicine, a sure cure for cold and fever and a component of many traditional Ayurvedic drugs.

1.2 Importance of the study

The scientist has shown that in India, there is short supply of milk and milk product and on large scale Indian population suffering from protein malnutrition. Taking into consideration the short supply of milk and milk product and protein malnutrition. It become necessary to find out suitable substitute for milk and milk product to meet shortage by using vegetable in to fulfilled the nutritional requirement of people. The basic need at this movement is to increase supply of milk and milk product at reasonable cost.

Milk being a perishable product gets spoiled quickly if not treated properly. Besides direct consumption as market milk, surplus milk is converted into various milk products as per the linking of the people from various region of the country. Delicious recipes are prepared from the milk by converting it in to desiccated, coagulated or fermented milk products.

Paneer is used in a variety of forms viz. base for variety of culinary dishes, ingredient for various vegetable dishes and snacks etc. The production of Paneer is now spreading throughout the world. The ability of Paneer to be deep fried is one feature that has led to its wider acceptance and a favourite for making snacks, pakoras or fried Paneer chunks. The by-product, “whey” obtained during paneer preparation can be used for kneading flour in the production of bakery products or can be converted into refreshing and nutritious drinks.

1.3 Objectives of study

However, available literature indicates that scanty work has so far been conducted on incorporation of Cumin and Black pepper in paneer. Henceforth, considering the medicinal value of Cumin and Black pepper, it is thought to undertake the research work on topic entitled "**Preparation of flavoured paneer**" with the following objectives :

1. To find out acceptable level of spices
2. To study sensory quality
3. To study the physico- chemical properties
4. To work out the production cost

1.4 Scope and limitations of study

Cumin and black pepper have various effects when used in foods. Not only they impart-flavour, pungency and colour characteristics; they also have anti-oxidant, anti-microbial, pharmaceutical and nutritional properties. The spice are used in comparatively small quantities in the food products. These are quite important ingredients, even indispensable, as their presence, even in small quantities does improve the eating qualities of the products, as well as the physical characteristics. In spicy paneer they will not only improve the taste but also improve the shelf life.

About 5% of milk produced in India is converted into Paneer. Paneer market size is around 15,500 tonnes at Rs. 1,860 million (USD 46.5 million). The unorganized sector, local sweet shops ('halwai's') account for most of the production. The market size for paneer is growing at 6-7 % per annum. Paneer is a rich source of protein available at a comparatively lower cost and forms an important source for vegetarians. Over and above its high protein content and digestibility, the biological value of protein in paneer is in the range of 80 to 86 (Khan and Pal, 2012).This indicates that there is tremendous opportunities for manufacturing and marketing of paneer. The development of flavoured paneer would further enhance the production of paneer, as it caters the needs of health loving consumers. Use of cumin and black pepper in paneer give good taste and can be utilized as snacks by deep fried. But when cumin and black pepper powder

is used in paneer and utilized as snacks , due to pungent taste small child may not accept same.

1.5 Hypothesis

Addition of cumin and black pepper in various milk products may help to maintain protein as well as fat level in the product in more or less manner. The product prepared from milk by addition of cumin and black pepper may be at reasonable cost and palatable to majority of the people to be kept under study. Such type of addition can be adopted for different milk product which may help in reducing the cost for every product at certain level and if increased can be compensated with flavour.

CHAPTER II

REVIEW OF LITERATURE

In recent year following a boom in the production and consumption of paneer, there has been a thrust on upgrading the existing technologies. The product technology and quality show wide variation as it is mainly produced on cottage scale. Most of the studies carried out by earlier research workers have shown the exhaustive use of cow milk, buffalo milk and combination of these milk for preparation of quality paneer.

Present study on ‘‘Preparation of flavoured paneer” by incorporation of cumin *(Cuminum cyminum Linn.)* and black pepper (*Piper nigrum*) powder” was undertaken with a view to find out the acceptable level of cumin and black pepper powder in paneer, to study the chemical and sensory properties and cost structure of flavoured paneer. The reviews pertaining to paneer and other related milk products is collected and grouped into different heads and presented in forgoing pages.

1. Technology
2. Type and quality of milk
3. Chemical composition
4. Utilization of spices in other dairy products
5. Sensory evaluation
6. Cost structure

2.1 Technology

2.1.1 Plain paneer

The research workers tried various methods for preparation of good quality paneer from different types of milk. The standardized methods of these workers explain the effect of process of manufacture of paneer on the quality of paneer.

Sanyal and Yadav (2000) prepared reduced fat paneer from partially Hypolysed buffalo milk (2% fat, 9% SNF) with 0.25 per cent added sodium chloride and cultured skim milk to milk prior to coagulation. Addition

of 2.5 per cent cultured skim milk was recommended for making a good quality reduced fat paneer with increased yield.

Kanawjia and Singh (2000) reported that a good quality paneer could be manufactured from milk with fat content as low as 3 per cent. Fortification of low fat milk with soy solids improved its rheological and sensory qualities.

Nayak and Bector (2001) prepared paneer from milk added with urea. Paneer was prepared from buffalo milk and skim milk standardized to fat SNF ratio of 1:1.65 and was divided into 3 equal parts, the two parts treated with solution of urea at 0.05 and 0.1 per cent of milk respectively and remaining part was used as control without urea addition.

Aneja et al. (2002) reported the traditional production process of paneer. Buffalo milk (6% fat, 9% SNF) was boiled in a vessel. To coagulate the milk a suitable coagulant (lime/alum/citric acid) added with slow stirring. Formation of clear whey indicative of complete coagulation. Stirring was stopped, as the coagulum tends to coalesce. After the formation of large lumps, contents of the vessel were poured over a muslin cloth to separate the coagulam from whey. The coagulum so obtained was lightly pressed to facilitate formation of paneer blocks of suitable size, followed by their immersion in chilled water to impart them a distinctive texture.

Bandyopadyay (2006) reported the standardized manufacturing process developed by NDDB for commercial production of paneer. For paneer production buffalo milk is preferred than cow milk because cow milk produces soft, meaty texture of paneer, unsuitable for frying. High heat treatment (90°C /no hold) of milk improves the solid recovery, yield, flavour, body and texture characteristic of paneer. Coagulation at 76^{o}C and pH 5.30-5.35 with one per cent citric acid solution produces best body and texture characteristics. Within 10 minutes of coagulation the curd chunk and sink to the bottom of the vat. After straining of whey the curd is transferred to hoops, lined with cloths. Four to five paneer hoops, containing 10 kg of paneer, are placed over one another and a pressure of 2-3 kg/sq.cm. is exerted using hydraulic press. The

processing time is around 15-20 minutes. The paneer blocks are cut and cooled to about 4^0C by immersing in chilled water.

Rajakumar (2007) conducted study was aimed at standardization of technology for the manufacture of in package functional paneer through concentration of milk by UF process followed by thermal texturization. The product so obtained was intended to have superior nutritional quality as well as good storage stability so as to overcome some of the lacunae associated with the conventional method of paneer manufacture. The processing parameters such as acid coagulation condition, pH of texturization and time-temperature combination for thermal texturization were optimized. Different variables such as fat, moisture, dietary fiber blend and calcium salts were optimized using Central Composite Rotatable Design (CCRD) of Response Surface Methodology (RSM). The optimum levels of 57.75 and 20.25 for fat (%DM); 59.50 and 66.50 for moisture (%); 5.25 and 5.25 for dietary fiber blend (%) and 100.49 and 100.50 mg Ca/ 100 g product for calcium salts were selected for the manufacture of full and low fat in-package paneer respectively. The full fat product was tested for hypocholesterolemic properties and calcium bioavailability in rats. The study indicated reduction in the plasma total and Low-density lipoprotein (LDL) cholesterol by 27.21 % and 26.54 %, respectively whereas calcium absorption and retention increased respectively by 87.09% and 79.47%. The shelf-life of full fat product with preservative (nisin at 500 IU/ g) was one month at 30±1°C whereas at refrigeration temperature (7°C), the product without preservative or with preservative remained acceptable for more than 4 month.

Karadbhajne and Bhoyarkar (2010) in the present study, buffalo milk is standardized on the level of fat (6 percent milk fat, 9 percent SNF) using different coagulants, was used in manufacturing of paneer. In case of ascorbic acid, the paneer prepared from 2% and 4 % ascorbic acid was found very good in terms of % yield, colour, flavour, taste, and even in terms of shelf life as compared to citric acid, lactic acid and tartaric acid.

Karande (2011) prepared paneer with cow milk and buffalo milk by using different coagulants viz., citric acid, lactic acid, tartaric acid,

with the level of 2 per cent each and lemon juice (fresh as such). He stated a flow diagram for the manufacture of paneer as follows,

Flow diagram

Milk
⇩
Filtration
⇩
Heat to 85°C
⇩
Add 1% citric acid in milk at 70°C
⇩
Draining of whey
⇩
Hooping and pressing
⇩
Cutting of curd into pieces
⇩
Chilling and brining
⇩
Storage of paneer

Reeta Kumar and Kumbhar (2012) carried out an attempt to developed paneer in that, milk was first filtered through double layered muslin cloth in order to remove dust and dirt particles and then separated by centrifugal cream separator for standardization purpose. Buffalo milk was standardized to 6% fat and 8.5% solid-not-fat (SNF) using buffalo skim milk and cream. The standardized buffalo milk was heated up to 90°C followed by cooling to 70°C for coagulation. Heat treatment aids in co-precipitating casein and whey proteins and also proved to increase the yield of paneer to some extent. Milk samples were coagulated at 70°C ± 1°C by adding 1% citric acid solution slowly to the milk with continuous and gentle stirring till a complete coagulation occurred and transparent greenish yellow whey separated out from coagulated mass. After coagulation of milk, the contents were left undisturbed for about five minutes. The whey then

removed by filtration through a double layered muslin cloth. The hot coagulum was transferred into a circular stainless steel hoop and pressed for 10 minutes by applying weight of 1.5 kg/cm^2 for texturization of coagulated mass. Coagulated paneer was dipped in chilled water for 5 minutes for good texture.

Saha et al. (2013) Paneer means the product obtained from cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70% moisture and the milk fat content shall not be less than 50% of the dry matter.

Priya Mishra (2013) conducted studies on “Value addition in paneer by the use of spices and salt”. She stated following flow diagram for the manufactured of paneer,

Flow diagram

Buffalo’s Milk

⇩

Standardized to 5% Fat and 8.5% SNF

⇩

Heating (85ºC)

⇩

Holding (5 minutes)

⇩

Cooling (70ºC)

⇩

Addition of coagulant (2% Citric acid Solution)

⇩

Setting of curd in whey (5 minutes)

⇩

Hooping and pressing

⇩

Immersion of paneer in chilled water (4-6ºC For two hrs.)

⇩

Packaging and storage

Smitha et al. (2014) in the present investigation, buffalo milk paneer was prepared under different coagulation temperatures to compare the yield, moisture content and whey drained from the prepared paneer. Also a correlational study was done between chemical constituents of milk viz. fat, SNF and total solids percent and yield of prepared paneer. It was concluded that the highest yield of paneer was obtained at coagulation temperature of 75°C with optimum moisture percentage. From the study it was also inferred that when milk was coagulated at 85°C and 70°C the yield was more influenced by fat but when milk was coagulated at 80°C and 75°C, SNF had got a significant effect on the yield of paneer. At 90°C and boiling temperature both fat and SNF had got a significant effect on the yield of paneer.

Prakasan et al. (2015) reported that paneer is a traditional Indian milk product popular among vegetarians for its nutritional and textural properties. Application of microbial transglutaminase (protein-glutamine-glutamyl transferase) (MTGase) in improving the physical and textural properties of paneer investigated. Paneer was prepared from milk treated with diiferent concentrations of MTGase using citric acid as a coagulant. Milk samples were treated with MTGase at 4°C for 18 h or 50°C for 1 hr. Parameters such as yield, cooking loss, water content and textural parameters were analysed. The batch treated with MTGase showed increased in yield at both the temperatures. MTGase at a concentration of 1 U/g of protein was found to be optimum in improving textural properties and water holding capacity while minimizing the cooking losses in paneer

Khatkar et al. (2017) studied on “Shelf life extension of paneer with the addition of Plant Essential Oil and Different Packaging Materials” and reported that for the manufacture of paneer, the vat and wooden stirrer were thoroughly cleaned and sterilized. Then filtered/ clarified and standardized (6% fat and 9% SNF) milk was taken in the vat. Occasional stirring was done during heating of milk, in order to prevent skin formation. The temperature of milk was raised to 80°C and maintained for 30 min followed by cooling to 70°C, and then coagulant (1% citric acid solution heated up to 70°C) @ 0.25 per cent of milk was added in a thin

continuous stream till complete coagulation was achieved as evidenced from the clarity of whey (greenish white tinge). The speed of stirring of milk during addition of the coagulant solution was maintained at 30-40 motions of the stirrer per min.

The time taken for addition of the coagulant was approximately 60-80 sec. The pH of whey ranged from 5.6 to 5.5. Before draining the whey, the contents of the vat were left undisturbed for 15 min. The coagulated mass was then collected in muslin cloth. Pressure was applied on the top of the coagulant mass by placing weight of app. 2 kg for about 15 min. The pressed paneer was removed from the muslin cloth, and cut into 2-3" size pieces, which were then immersed in chilled water (4°C) for 2-3 hr. The pieces of chilled paneer were then removed from water and placed on wooden planks for about 10-15 min to allow loose water to drain.

Sughanya and Lalitha (2017) manufactured paneer by blending of coconut milk with cow's in the ratio of 75:25,50:50, 25: 75 and 0:100. The blended milk was then heated to 82°C and cooled to 72°C. It was then coagulated with vinegar. Whey was drained off from the curd and pressed. The paneer was dipped in chilled water (4-5°C) for 2-3 hours and it was then kept for draining for 10 minutes to drain off loose water.

2.1.2 Paneer (with spice)

Desale (2012) carried out studies on "Efficacy of herbal preservatives to enhance shelf life of paneer". Paneer was manufactured by using different herbal preservatives viz., black pepper, cardamom, clove, black pepper + clove, black pepper + cardamom and clove + cardamom. He has noted the flow diagram for the manufacture of paneer as follows,

Flow diagram

⇩

Cow milk (Standardized to 5.5 % fat)

⇩

Filtration

⇩

Heating to 90°C for 5 minutes

⇩

Cooling to 70°C

⇩

Addition of Coagulant – Citric acid @1 % at 70°C

⇩

Coagulation (pH 5.30-5.35)

⇩

Holding for 10 minutes

⇩

Drainage of whey

⇩

Curd ⇦ Addition of herbal preservatives

⇩

Proper mixing of preservative in to coagulum

⇩

Lining of muslin cloth into block and addition of paneer into block

⇩

Pressing (Piling and repiling)

⇩

Removal of paneer from block

⇩

Cutting of paneer into required size

⇩

Chilling (4°C)

⇩

Removal of paneer cubes from chilling water

⇩

Allow to drain water

⇩

Packaging

⇩

Refrigerated storage (5-7°C)

Priya Mishra (2013) conducted research on “Value addition in paneer by the use of spices and salt”. She used five different types of spices viz., garlic, ginger, cumin, mint and mixed spices for the manufacture of paneer and reported following flow diagram for the manufacture of paneer,

Flow diagram

Buffalo’s Milk

⇩

Standardized to 3%, 4%, 5% fat and 8.5% SNF

⇩

Heating 85°C

⇩

Cooling 70°C

⇩

Add Spices directly into the milk (1%, 1.5%, 2%)

⇩

Coagulation 70°C (with 2% citric acid solution)

⇩

Setting of curd in whey (5 minutes)

⇩

Straining through muslin cloth

⇩

Hopping and Pressing

⇩

Immersion of paneer in chilled (at 4-6°C for 1-2 hours)

⇩

Application of Salt (2%)

⇩

Storage (wrapping in parchment paper)

Monika Rani et al. (2014) prepared a paneer using whole milk paneer along with marinate of whole milk (4.5 % fat, 8.5 % solid not fat) curd with spices (2.5% cumin, 2.5 % coriander, 2 % salt, 2 % sugar, 10 % ginger and 5% garlic) and 1.25 % red pepper and 0.25% black pepper in second product instead of ginger and garlic for 60 min. One batch was packed in polyethylene pouches and sealed. The second batch was heated after packaging in polyethylene pouches at 15 pound per square inch (psi) for 10 min. Nutritional results revealed that 16 % of daily reference value

(DRV) of energy, 33.3% of DRV of protein and 26 % of DRV of calcium could be met from single serving of 100 g spice paneer. The products were microbiologically safe and remained so for six days in refrigerated storage.

Singh et al. (2014) carried out studies to evaluate the properties of turmeric incorporated paneer prepared from different types of milk, i.e. cow milk, buffalo milk and mix milk and stated flow diagram for the manufacture of paneer as follows,

Flow diagram

Fresh milk

⇩

Heated at 82°C

⇩

Addition of turmeric @ 60 ml/litre of milk extract

⇩

Mixing and kept for 5 minutes at 82°C

⇩

cooling to 70°C

⇩

Addition of 2% citric acid solution

⇩

coagulation

⇩

Kept the curd in the whey for 5 minutes at 63°C

⇩

Draining of whey

⇩

Pressing of curd (3 kg/cm^2) for 20-30 minutes

⇩

Chilling of paneer in water at 4°C/2 hrs.

⇩

Packed in aluminium foil and stored at room temperature and refrigerated temperature

Kumari et al. (2015) concluded from the study that addition of black pepper, cardamom and clove in paneer at the rate greater than 0.6 % and cinnamon at the rate greater than 0.4 % was found to be acceptable. Addition of black pepper, cardamom or clove at the rate of 0.6 % or cinnamon at the rate of 0.4 % improves shelf life of paneer on storage at 7 °C. The order of the relative effectiveness in enhancing shelf life of paneer is cardamom > cinnamon > clove > black pepper. Among the spices studied, cardamom was found to be the best spice to improve shelf life of paneer up to 28 days as 7 ± 1 °C of storage.

Richa Badola et al. (2018) presented study was designed to develop herbal paneer by incorporating herbs viz., black pepper (0.25%) and cardamom powder (0.50%) and its quality parameters (pH, titratable acidity, TSS, moisture content, ash content, fat content, protein content, phenolic content and sensory parameters) were evaluated and compared with control sample. The results revealed that the herbal paneer was organoleptically better than control samples, while no or least effects were found on the proximate and physiochemical parameters of the paneer. The total phenolic content was found to be slightly higher in herbal paneer sample, indicating possibility of use of herbs to develop a novel functional dairy product with enhanced antioxidant properties and ultimately enhanced shelf-life.

2.2 Type and quality of milk

Chavan et al. (2007) recommended addition of 20 parts of buffalo skim milk to 80 parts of cow whole milk for production of better quality paneer.

Salunkhe (2007) carried out studies on “Effect of blending goat and buffalo milk on physico-chemical and sensory characteristics of paneer” and concluded that goat milk could be successfully utilized for preparation of paneer in combination with buffalo milk. The most acceptable quality paneer can be prepared by using buffalo and goat milk in 75:25 proportion.

Salve et al. (2007) prepared low fat paneer from buffalo milk added with whey protein concentrate (WPC). Paneer was prepared from buffalo milk standardized to 6 per cent fat and at lower fat level viz., 5 per cent, 4 per cent and 3 per cent. Further to improve the sensory quality of low fat paneer whey protein concentrate was incorporated at different levels, results revealed that the quality attributes of paneer differed significantly with lowering of fat from 6 to 3 per cent except appearance. The sensory score for body, texture and overall acceptability of 4 per cent milk fat paneer and control paneer are comparable. Paneer made from 6 per cent fat and 5 per cent fat has almost similar recovery of total solids and fat. Whey protein concentrate at rate of 2 per cent found most effective for improving quality attributes of low fat paneer.

Khan and Pal (2010) conducted study to evaluate the quality characteristics of paneer made from reconstituted milk of higher total solid content. To improve the quality of paneer from high solid reconstituted milk calcium phosphate was incorporated at different levels viz., 1, 1.5 and 2 per cent prior to acidification. It might be concluded that the addition of 1.5 per cent calcium phosphate to the reconstituted milk prior to acidification would help in developing paneer with more desirable characteristics in terms of TS recovery, yield as well as sensory quality.

Khan et al. (2012) made an attempt to prepare paneer of desirable quality from whole milk powder. Various reconstitution levels of WMP (WMP : water) viz., 1:2, 1:3, 1:4, 1:5 and 1:6, along with control (fresh milk), were used for the manufacture of paneer. The study revealed that a paneer of desirable quality comparable with control milk paneer can be prepared from reconstituted milk with 1:5 or 1:6 level of reconstitution. Reconstitution levels below 1:5 level has some adverse effects on the quality of paneer, although all the paneer samples were acceptable.

Ruby Kumari et al. (2013) prepared Filled milk dietetic paneer is a heat and acid coagulated dairy product prepared by blending of milk fat, vegetable fat and soymilk in contrast to paneer, which is made from milk fat only. It is rich in protein, vitamins and minerals low in saturated fat but rich in polyunsaturated fatty acids (PUFA). The formulation with

substitution of 3:2 (cow milk fat: vegetable fat) and 20% soy milk was found to be the most appropriate for manufacture of filled milk detetic paneer Textural parameter of filled milk paneer on a texture analysis were 837.76 g for hardness, 681.87 for gumminess, 463.08 g for chewiness and 0.348 resilience.

Singh et al. (2014) conducted a study to evaluate the properties of turmeric incorporated paneer prepared from different types of milk, i.e. cow milk, buffalo milk and mix milk. The present study entailed to conclude that addition of turmeric in paneer prepared from either cow milk, buffalo milk or mix milk at the rate greater than 0.6 % by weight of expected yield of paneer results into sharp decline in sensory score and texture of paneer but it is still acceptable and safe for usage. Addition of turmeric at the rate of 0.6 % by weight of expected yield of paneer and packed in aluminium foil extends the shelf life of paneer up to 15 days on storage at refrigerated temperature(below 5°C).

Supekar et al. (2014) carried out research to assess the suitability of goat milk incorporation in preparation of paneer on the basis of sensorial properties and to observe the effect of goat milk addition of nutritional and microbial quality of paneer. Different proportions of goat milk (viz., 25, 50 and 75%) were used as replacement of buffalo milk and effect of different proportions on sensorial quality characteristics, chemical composition and microbial profile was evaluated. The results showed that increasing proportion of goat milk incorporation reduced sensorial, nutritional and microbial quality of paneer. However, results of overall acceptability showed that sample containing 25 per cent goat milk observed to be under very much liked sample among the other treatments without significantly affecting the sensory quality profile of paneer.

Guraddi et al. (2016) conducted study with an aim to improve the textural attributes and yield of paneer. Different coagulation temperatures and different coagulants were employed. Pre treated milk for paneer preparation was coagulated at 65, 70 and 75°C, and the prepared paneer was subjected to sensory and chemical evaluation, which showed the paneer prepared by coagulating at 70°C had better overall acceptability

and was found to contain 22.55, 18.67% fat and protein respectively and the yield was recorded 17.61%. The paneer milk optimized for coagulation temperature was added with two different coagulants citric acid and acetic acid, the best results were obtained for citric acid, which had 18.56% protein and 22.51% fat with maximum overall acceptability. The study shows the importance of coagulation temperature and coagulants on final quality of paneer.

2.3 Chemical composition

2.3.1 Milk

De (2011) reported the chemical composition of cow and buffalo milk as :

Constituents	Buffalo milk (%)	Cow milk (%)
Water	84.2	86.6
Fat	6.6	4.6
Protein	3.9	3.4
Lactose	5.2	4.9
Ash	0.8	0.7

Sonali Jadhav (2012) stated the composition of buffalo milk as given below :

Sr. No.	Constituents	(%)
1.	Total solids	15.73
2.	Fat	6.46
3.	Protein	3.82
4.	Acidity	0.14

Ghule (2015) stated the composition of buffalo milk as given below:

Sr. No.	Constituents	%
1.	Total solids	16.06
2.	Fat	6.54
3.	Protein	4.04
4.	Acidity	0.14
5.	Ash	0.80

Chorage (2016) stated the composition of buffalo milk as given below :

Sr. No.	Constituents	%
1.	Total solids	15.53
2.	Fat	6.22
3.	Protein	3.87
4.	Acidity	0.141
5.	Ash	0.79

2.3.2 Paneer

Chandan (2007) reported that the low fat paneer is available in western countries, which contains 24% fat on dry matter (FDM), skim milk paneer containing 13% FDM, is also feasible, but the product has a chewy, rubbery, and hard body.

Desale et al. (2009) made an attempt to evaluate the chemical and microbiological quality of paneer marketed in Ahmednagar city of Maharashtra state. The quality of paneer was assessed in terms of physical, chemical and microbiological attributes. The samples were collected from the various locations of the Ahmednagar city and grouped in to seven different categories (A to G). The moisture content was ranged from 42.62 to 60.39 per cent. While for fat content from 16 to 28 per cent and for protein content ranged from 15.06 to 20.33 per cent. The average standard plate count per gram of market samples of paneer ranged from 1 x 104 to 224 x 105 cfu/g. The average number of coliform per gram of paneer samples in the range of 12.6 x 103 to 23.2 x 103 cfu/g. The yeast

and mould count per gram of paneer ranged between 1 x 102 and 99 x 102 cfu/g.

De (2011) mentioned average chemical composition of paneer (made with 6 percent fat) as : moisture 54.7 percent, total solids 45.3 percent and fat 26.00 percent.

Karande (2011) studied on “Effect of different coagulants on physico-chemical and sensory quality of paneer prepared from milk of cow and buffalo” and reported its chemical quality as an average total solids content 47.54, 47.89, 45.61, 47.28 per cent, fat content 25.23, 25.52, 23.86, 24.55 per cent, protein content 17.08, 17.04, 17.04, 16.95 per cent, ash content 1.98, 1.92, 1.94, 1.81 per cent and titratable acidity 0.65, 0.67, 0.71, 0.75 per cent for treatments T_1, T_2, T_3, and T_4 respectively i.e. citric acid (T_1), lactic acid (T_2) , tartaric acid (T_3), and lemon juice (T_4).

Desale (2012) conducted research on “ Efficacy of herbal preservatives to enhance shelf life of paneer” and reported chemical composition of paneer as fat 24.52 per cent, protein 17.10 per cent, lactose 2.00 per cent, ash 1.92 per cent, moisture 54.46 per cent and acidity 0.515 per cent. The herbal preservatives viz; Black Pepper, Cardamom, Clove, Black Pepper + Clove, Black pepper + Cardamom and Clove + Cardamom in combination were used in paneer. The herbal preservatives was incorporated in the product at the rate of 0.0 (control), 0.2, 0.4, 0.6 and 0.8 per cent by weight of yield of paneer. 0.6 per cent addition of herbal preservatives in single or in combination has been used in preparation of paneer in main experiment.

Priya Mishra (2013) carried out research on “Value addition in paneer by the use of spices and salt. She used five different types of spices viz., garlic, ginger, cumin, mint and mixed spices for the manufacture of paneer and she reported chemical quality of paneer as follows,

Sr.No	Constituents	%
1.	Fat	23.68
2.	Protein	15.99
3.	Moisture	56.05
4.	Ash	1.52
5.	Lactose	2.05
6.	Total solids	43.95
7.	Acidity	0.19

2.3.3 Cumin

Chadha (2006) reported chemical composition of cumin as given below:

Sr. No.	Ingredients	Percentage (%)
1.	Volatile oil	2.5-3.5
2.	Protein	17.7
3.	Fat	23.8
4.	Carbohydrate	35.5
5.	Minerals	7.7

Nisha Chaudhary et al. (2014) reported chemical composition of cumin as given below:

Sr.No.	Constituents	%
1.	Fruit volatile oil	1.90
2.	Trans-dihydrocarvone	31.11
3.	Ɣ-terpinene	23.22
4.	p-cymene	15.8
5.	α-phellandrene	12.01
6.	p-menth-2-en-7-ol	3.48
7.	Cuminaldehyde	0.58

Rong and Jiang (2004) stated chemical composition of the cumin as given below,

Sr.No.	Constituents	%
1.	Cuminal	36.31
2.	cuminic alcohol	16.92
3.	γ-terpinene	11.14
4.	Safranal	10.87
5.	p-cymene	9.85
6.	β-pinene	7.75

Ramasamy et al.(2013) mentioned chemical composition of cumin as given below:

Sr.No	Constituents	%
1.	Cuminal	8-17
2.	β-pinene	22-27
3.	β-myrcene	1.3-1.75
4.	ρ-cymene	23-39
5.	γ-terpinene	11-27
6.	ρ-mentha-1,4-dien-7-ol	1.0-5.5

Parthasarathy et al. (2008) has given nutrient profile of cumin (in 100 g of seeds).

Sr.No.	Nutrient	Amount
1.	Calories	375Kcal
2.	Protein	18g
3.	Dietary fibre	11g
4.	Carbohydrates	44g
5.	Total fat	22g
6.	Water	8g
7.	Ash	8g

Singh et al. (2017) recorded that cumin seeds contain aldehyde (60%) fats, amino acids, flavonoids and glycosides (22%), volatile oil (2-5%) and the yellow colored fresh oil contains cuminaldehyde as its chief

component. The major compounds occurring in cumin are cuminaldehyde, limonene, α- and β-pinene, 1, 8-cineole, o-and p-cymene, α- and γ–terpinene, safranal and linalool

Gotmare and Tambe (2018) stated chemical composition of extracted cumin oil and market cumin oil under study as given below:

Name of the compound	**Cumin extracted from whole seed (%)**	**Market oil content (%)**
α-Pinene	-	0.15
β-Pinene	1.58	1.63
p-cymene	6.67	17.36
Eucalyptol; 1,8-cineole	0.46	
γ-Terpinene	0.36	3.51
p-Menth-3-en-7-al	1.11	-
Cuminaldehyde	74.62	64.31
α-Terpinen-7-al	3.98	4.59
Cumic acid, 4-(1-methylethyl)-benzoic acid	0.97	1.43

Rana (2014) reported that essential oil from the seeds of *Cuminum cyminum L*. was isolated by hydrodistillation method and the chemical composition was determined by gas chromatography-mass spectrometry (GC/MS). The yield of the oil was found to be 3.0% (on dry weight basis). Some components, representing in table given below,

Sr.No.	**Constituents**	**%**
1.	Oil	96.7
2.	Cuminaldehyde	49.4
3.	p-cymene	17.4
4.	β-pinene	6.3
5.	α-terpinen-7-al	6.8
6.	Γterpinene	6.1
7.	p-cymen-7-ol	4.6
8.	Thymol	2.8

2.3.4 Black pepeer

Chadha (2006) reported chemical composition of blackpepper as given below:

Sr. No	Ingredients	Percentage (%)
1.	Oleoresin	11.8
2.	Piperine	5.3
3.	Essential Oils	3.5

Nelson and Cannon-Eger (2011) stated components of black pepper per 100 gram as given below:

Sr.No.	Component	Black pepper(%)
1.	Water	9.5-12.0
2.	Protein	10.9-12.7
3.	Starch	25.8-44.8
4.	Fiber	9.7-17.2
5.	Ash	3.4-6.0
6.	Piprine (pungent)	4.9-7.7

Meghwal et al. (2012) reported Antioxidant active chemicals isolated from black pepper as given below:

Sr.No.	Constituents	Ppm
1.	Ascorbic-acid	0–10
2.	Beta-carotene	0.114–0.128
3.	Lauric-acid	400–447
4.	myristic-acid	700–782
5.	palmitic-acid	12,200–13,633
6.	Piperine	17,000–90,000

Parthasarathy et al. (2008) has given nutritional composition of black pepper per 100 g.

Sr.No.	Constituents	
1.	Water	8.0g
2.	Food energy	400.0Kcal
3.	Protein	10.0g
4.	Fat	10.2g
5.	Carbohydrates	66.5g
6.	Ash	4.6g
7.	Calcium	0.4g
8.	Iron	17.0mg

Morshed et al. (2017) reported physico-chemical parameters of Black pepper as given below:

Sr.No.	Parameters	%
1.	Caryophyllene	19.12
2.	Limonene	9.74
3.	Camphene	8.44
4.	Moisture	2.20
5.	Dry matter	96.12
6.	Protein	12.66
7.	Fatty oil	14.41
8.	Ash	12.49
9.	Carbohydrate	42.56
10.	Crude fiber	5.55

2.4 Utilization of spices in various dairy products

Rajanikant et al. (2005) Studied at National Dairy Research Institute (NDRI), Karnal, India and develop herbal ghee by incorporating functional attributes of Arjuna herb has been developed for providing beneficial effects against cardio-vascular diseases (CVD); such product had greater stability against oxidation as compared to conventional ghee. The consumer acceptability of such Arjuna ghee was very good.

Bandyopadhyay et al. (2007) reported antioxidative effect of herbal sandesh decreased in the order: turmeric>curry leaf >aonla >spinach>coriander leaf. The total antioxidative potency of herbal sandesh was lower than sandesh samples containing tertiary-Butylhydroquinone (TBHQ), but similar to those containing 200mg/kg beta hydroxy acid (BHA) and butylated hydroxytoluene (BHT) (1:1 w/w). Incorporation of coriander as herb resulted in increased shelf-life of herbal sandesh up to 8 days and 30 days respectively, when stored at 30±1°C and 7±1°C.

Behrad et al. (2009) determined the effects of herbs on yoghurt fermentation, the level of probiotic bacteria in yoghurt during 28 days storage and the effect of herbal yoghurt on the growth of *H. pylori* in vitro. Cinnamon or licorice was mixed with milk and the mixture was fermented with probiotic bacteria to form herbal-yoghurt. Changes of pH and total titratable acids were monitored and the viability of probiotic bacteria was evaluated during and after refrigerated storage. The present findings indicate cinnamon and licorice has bioactive components to decrease the growth of *H. pylori*.

Pinto et al. (2009) studied different forms of ginger i.e., ginger juice @ 4%, ginger shreds @ 4%, sugar syrup treated ginger shreds @ 6% and ginger powder @1% were used to prepare ‘ginger flavoured herbal ice cream’ and compared against a control ice cream made using vanilla flavouring. Incorporation of ginger juice or ginger shreds (sugar syrup treated) at rate of 4% by weight of ice cream mix is recommended for obtaining acceptable quality ‘ginger flavoured ice cream’

Landge et al. (2011) carried out research on suitability of adding ashwagandha powder into shrikhand. Ashwagandha powder @ 0.3%, 0.5% and 0.7% with 40% cane sugar (by weight of Ashwagandha powder @ 0.3%, 0.5% and 0.7% with 40% cane sugar (by weight of chakka) was mixed for manufacture of shrikhand. The samples were stored at 7°C and sensory and microbial qualities evaluated at regular interval. microbial qualities evaluated at regular interval. Shrikhand prepared by addition of 0.5 % ashwagandha powder (T_2) was superior in organoleptic

parameter followed by T_3 , T_1 and T_o, respectively. The treated product was acceptable up to 52 days of storage under refrigerated temperature

Samy (2011) reported that addition of clove essential oil (MIC of 2.0%) showed antibacterial effect against E. coli and vancomycin-resistant Enterococci in feta cheese stored at 7ºC for 14 days.

Kumar et al. (2013) developed a herbal flavoured spread based on Yoghurt concentrate (60% TS) was prepared by allowing the whey to drain from yoghurt. To this yoghurt concentrate, salt and coriander were added at the same rate of 2% by weight. For optimization of mint level, the mashed raw leaves were added at 2, 4 and 6% by weight of yoghurt concentrate. The yoghurt spread prepared with 2% mint had higher sensory scores than the ones prepared using higher (i.e. 4 and 6% levels) rate of addition. The shelf life of the spread was 10 days when stored at 5ºC. Such mint flavoured yoghurt spread is recommended for use in sandwiches, burgers, chapattis and other leavened bakery items.

Parmar et al. (2013) found that addition of ethanolic extract of T. Arjuna bark at 7% by weight was highly effective in retarding the auto-oxidation of both cow and buffalo ghee during storage. Ethanolic extract of arjuna herb showed significant ability to enhance the antioxidant potential of ghee; the efficacy was more pronounced in case of cow ghee compared to buffalo ghee. The shelf life (accelerated test) of the Arjuna herbal ghee at 80±1°C was 8 days as compared to just 2 days for control ghee sample (devoid of herb).

Gandhi and Lal (2014) reported that a functional Lassi and Dahi were developed by supplementing the herb aloe vera and probiotics. Animal study of such herbal lassi revealed that it exerted better immunoprotective effects as compared to control lassi. Supplementation of aloe vera supported the growth of probiotic strain in fermented product. The probiotic viability was >7 log10cfu/ml during 12 days storage period.

Thabet et al. (2014) reported that (23.70% TS) containing 0.3% of cinnamon essential oil had greater shelf life (i.e. 8 days in excess) as compared to control product, when stored at 6°C.

2.5 Sensory Evaluation

Desai (2007) narrated the desirable sensory attributes for paneer. Flavour is a characteristic blend of flavour of heated milk and acid, i.e. pleasant, mildly acidic and sweet (nutty). Body and texture should be sufficiently firm to hold its shape during cutting/slicing yet tender enough not to resist crushing during mastication. Texture should be compact, smooth and velvety. Colour and appearance should be uniform, pleasing white colour with greenish tinge in case of buffalo milk paneer and light yellow for cow milk paneer.

Bhadekar et al. (2008) Paneer was prepared from different proportions of buffalo milk and sago powder 99.7: 0.30 (T_1), 99.6: 0.4 (T_2), 99.5: 0.5 (T_3) and control (T_0) with 100 % buffalo milk with object to study sensory evaluation and overall acceptability of paneer. The mean overall acceptability scores were observed as 8.91, 8.51, 7.96 and 7.40 for treatments T_0, T_1, T_2 and T_3 respectively. Overall acceptability showed a decreasing trend with increase in level of sago powder.

Kumar et al. (2008) found that the sensory score of paneer decreased with an increase in the level of incorporation of the coagulant i.e. from 0.2 to 0.6 per cent.

Kumari (2009) evaluated eight different spices viz. black pepper, cardamom, cinnamon, clove, garlic, ginger and onion for extending the shelf life of paneer. Addition of black pepper, cardamom or clove at the rate of 0.6 per cent or cinnamon at the rate of 0.4 per cent improves shelf life of paneer on storage at 7°C. The order of the relative effectiveness in enhancing shelf life of paneer is cardamom > cinnamon > clove > black pepper.

Buch (2010) evaluated seven different herbs viz. ajwain, asafoetida, coriander, cumin, fenugreek, mint and turmeric for extending the shelf life of paneer. Amongst 7 different herbs turmeric was found most effective. Addition of turmeric at the rate of 0.6 per cent extends the shelf life of paneer up to 12 days on storage at 7°C±1°C.

Smita Khodke et al. (2014) found that the soygroundnut paneer prepared from the proportion 70:30, 60:40, 50:50,was fragile and brittle texture and obtained less score for all the sensory attributes. It was observed during experimentation that as groundnut milk percentage increased. This may due to the more fatty acids present in the groundnut. It was observed that body and texture and overall acceptability of proportion 90:10, 80:20, were equivalent to 100 percent soymilk paneer

Maske et al. (2018) reported the average score for colour and appearance of paneer prepared by toned milk using sago powder was ranged between 6.38 to 8.75 for T_4 and T_1, respectively. Sago paneer prepared under control treatment (T_1) was found to be superior over the rest of the treatments. Statistically the colour and appearance score for all the treatments were differ significantly with each other. The maximum score was found in T_1 whereas minimum score was recorded in T_4. It is observed that more levels of sago powder lowered the score of paneer for colour and appearance. It indicated that up to 2.5 parts of sago powder did not have any masking effect on the finished product as far as colour and appearance was concerned.

Singh et al. (2018) Studied preparation of paneer by using buffalo milk and mint and studied for its sensory properties. In the present study T_0, T_1, T_2, T_3 and T_4 were formulated in which paneer was prepared by using buffalo milk and mint was in the ratio of (100:00, 98:2, 96:4, 94:6 and 92:8) respectively. The sensory score for overall acceptability of mint paneer of treatments T_0, T_1, T_2, T_3 and T_4 was found to be 7.73, 7.93, 8.06, 7.66 and 7.42 respectively. Overall acceptability score of paneer by using buffalo milk and mint and control milk, highest mean score of overall acceptability was recorded in T_2 (8.06) followed by T_1 (7.93), T_0 (7.73), T_3 (7.66) and T_4 (7.42). It was found that among all treatments T_2 (8.06) higher score in sensory evaluation and considered as optimized product of mint paneer.

2.6 Cost structure

Sarika Patil (2003) find out the production cost of paneer with combination of coconut milk for treatment T_1, T_2, T_3, T_4 is Rs.122.37, 94.46,

99.06 and 103.79 Rs. per kg. respectively. The cost of production of paneer in T_2 treatment was lower down by 22.80%, 4.64% and 8.98% as compared toT_1, T_3 and T_4 respectively.

Desale (2012) concluded that the cost of production of paneer with addition of different preservatives to enhance shelf life of paneer by using different herbal preservatives viz., black pepper, cardamom, clove, black pepper + clove, black pepper + cardamom and clove + cardamom. Cost ranged from Rs.116.84 to 117.14 per kg of paneer.

Kokate (2012) concluded that the production cost of paneer decreases with addition of soymilk at various levels. The production cost of paneer at T_1, T_2, T_3, T_4 and T_5 levels was Rs. 218.44, 197.94, 163.36, 144.88 and 115.56 Rs per kg respectively. The production cost of paneer at most acceptable level i.e. incorporation of soymilk up to 25% for preparation of paneer was acceptable as buffalo milk paneer was Rs. 197.94 per kg

Gediya (2014) concluded that the cost structure of paneer by addition of amla juice as a coagulant. The cost of milk having 5 per cent fat and 8.25 per cent SNF is Rs.40 per kg. Utilities cost and labour costs are also included for the manufacture of Paneer that which are Rs.11.55 and Rs.31.00 respectively. The yield of Paneer obtained employing this standardized process is 17.7 per cent. The total cost of the batch produce is Rs.168.55 which when converted to per kg comes to Rs.318.02 per kg of Paneer.

David (2014) calculated that an acceptable low cost paneer can be prepared by using peanut milk and skim milk blend the cost production off peanut paneer was comparatively lower than the control paneer.

Mrunali Mhatre (2018) noticed that cost of paneer production was increased simultaneously with increase in the level of ginger juice. The cost of paneer production at T_0, T_1, T_2, T_3 and T_4 levels was ₹ 242.20, 245.70, 247.10, 249.30 and 252.50 per Kg., respectively. The production

cost of paneer at most acceptable level i.e. paneer with 1.5 per cent ginger juice was ₹ 245.70per Kg.

Priyanka Shirsat (2016) reported that cost of production of paneer was decreased with increase in level of peanut milk for treatments T_1,T_2, T_3, T_4 and T_5 were Rs.255.30, 231.50, 227.60, 226.00 and 214.35 Rs per kg respectively. The production cost of paneer at most acceptable level i.e. incorporation of peanut milk up to 25% for preparation of paneer was acceptable as cow milk paneer was Rs 231.50 per kg.

CHAPTER III

MATERIAL AND METHODS

The study entitled “Preparation of Flavoured Paneer” was carried out at the Department of Animal Husbandary and Dairy Science, Dr.PDKV, Akola during the year 2018-2019. The details of material and methods followed are indicated here under.

3.1 Materials:

3.1.1 Milk : Fresh, clean whole buffalo milk was procured from Livestock Instructional Farm of Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola and utilized for preparation of flavoured paneer.

3.1.2 Ingredients: Citric acid, Cumin, Black pepper, salt was purchased from the local market.

3.2 Methodology:

3.2.1 Preparation of Cumin and Black pepper powder Powder:

Good quality cumin and black pepper was purchased from local market of Akola city. Both was graded in mixer and use for experiment purpose.

3.2.2 Preparation of Paneer :

Paneer was prepared as per the procedure standardized by Aneja et al. (2002) with slight modifications, as per flow diagram given below,

Flow Diagram

Buffalo milk

⇩

Pre-heating (35-40°c)

⇩

Filtration

⇩

Heat to 82°c for 10 minutes

⇩

Boiling of milk

Separation of whey and coagulum

Drainage of whey

Pressing of coagulum

Plate 1. Preparation of paneer

Add coagulant (2 % citric acid) in milk at 70°c

⇩

Addition of Cumin powder / Blackpepper powder / Cumin+Blackpepper

powder as per treatment

⇩

Draining of whey (15 min)

⇩

Collection of solid mass

⇩

Mixing

⇩

Pressing in paneer hoop (@ 2kg/ sq.cm for 20 min.)

⇩

Paneer

⇩

Brine treatment (5%)

⇩

Cutting into cubes

⇩

Storage (5-7°c)

3.3 Treatments :

T_1 = Control – Paneer as per Standard

T_2 = Paneer blended with 0.2 % cumin powder

T_3 = Paneer blended with 0.4 % cumin powder

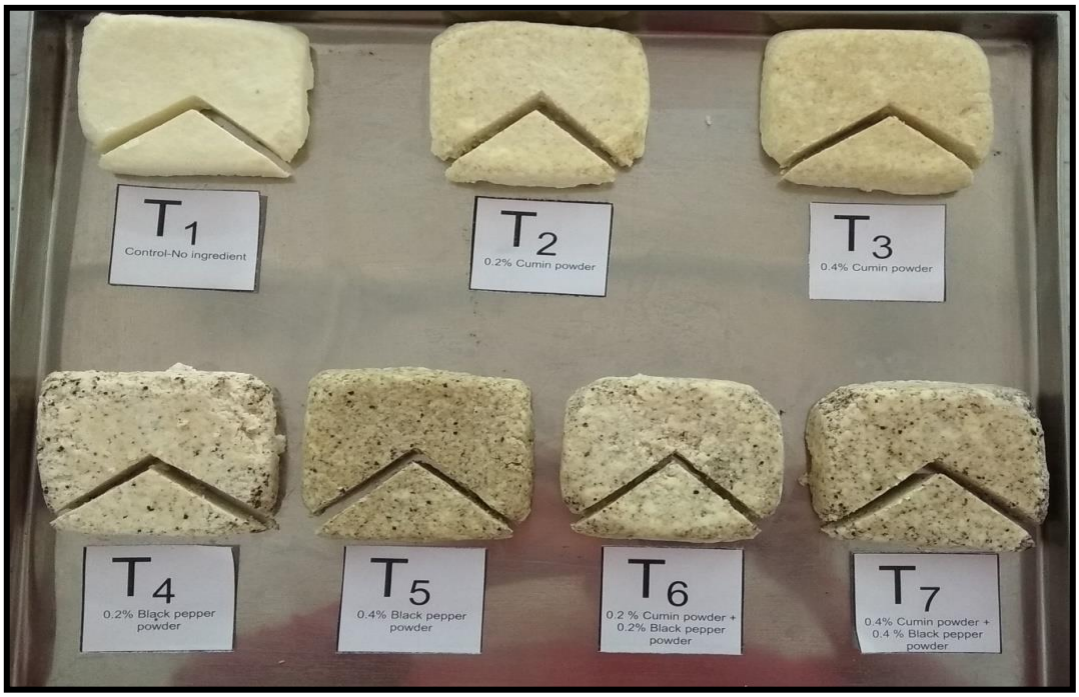
T_4 = Paneer blended with 0.2 % black pepper powder

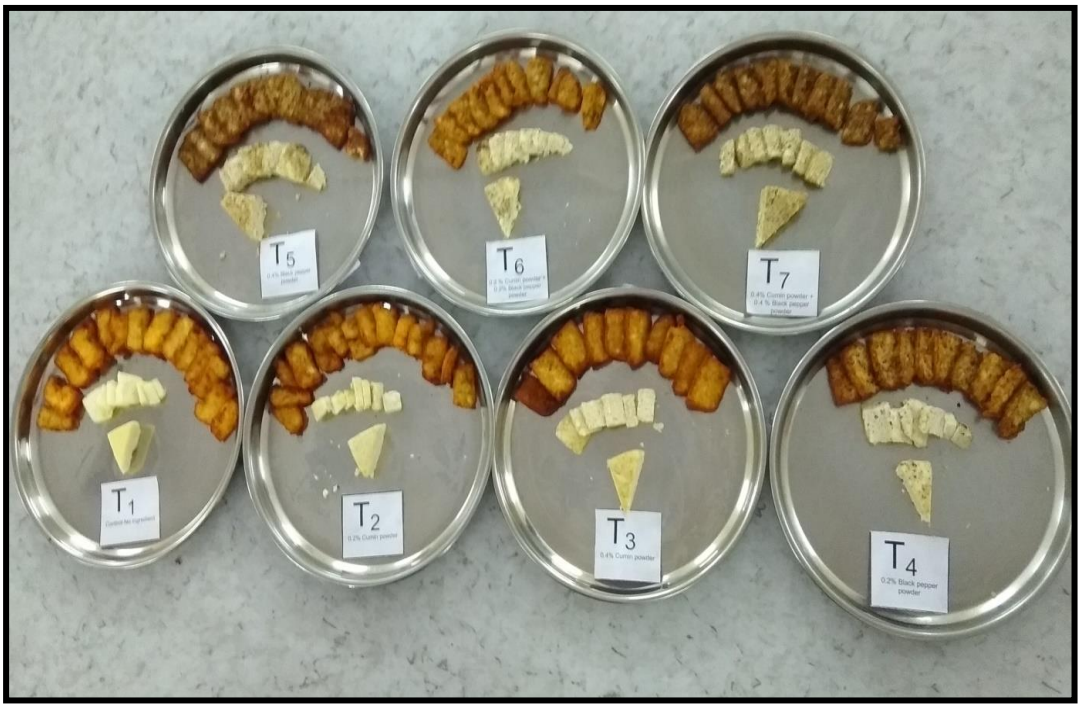
T_5 = Paneer blended with 0.4 % black pepper powder

T_6 = Paneer blended with 0.2 % cumin powder + 0.2 % black pepper powder

T_7 = Paneer blended with 0.4 % cumin powder + 0.4 % black pepper powder

3.4 Replications: All treatment was conducted with four replications.





Treatments

Plate 2. Paneer samples as per treatment

3.5 Analytical methods

3.5.1 MILK:

3.5.1.1 Total solids: The total solids content was determined by gravimetric method as per IS:1479 (Part II), 1961.

3.5.1.2 Fat: The fat content was determined by using standard Gerber method as described in IS:1224 (Part I),1977.

3.5.1.3 Protein: The protein was determined by estimating the per cent Nitrogen by micro-kjeldhal method as recommended in IS:1479 (Part II), 1961. The per cent nitrogen was multiplied by 6.38 to find out the protein percentage in milk.

3.5.1.4 Ash: Ash content of paneer was determined as per the method described in A.O.A.C.(1975)

3.5.2 PANEER

3.5.2.1 Total solids: The total solids content was determined by gravimetric method as per IS:1479 (Part II), 1961.

3.5.2.2 Fat: The fat content was determined by using standard Gerber method as described in IS:1224 (Part I),1977.

3.5.2.3 Protein: The protein content was determined by estimating the per cent nitrogen by microkjeldhal method as recommended in IS:1479 (Part II), 1961. The per cent nitrogen was multiplied by 6.38 to find out the protein percentage in paneer.

3.5.2.4 Titratable Acidity: The acidity of paneer expressed as per cent lactic acid was determined by the method described in IS:1479 (Part I),1960.

3.5.2.5 Ash: Ash content of paneer was determined as per the method described in A.O.A.C.(1975).

3.6 Sensory Evaluation: The product was evaluated for flavour, colour, appearance, body & texture, taste and finally overall acceptability was carried out by using 100 point numeric score as described by Pal and Gupta (1985).

Determination of fat

Observation of fat

Determination of titratable acidity

Determination of protein

Determination of total solids

Determination of ash

Plate 3. Chemical analysis of buffalo milk and paneer

Score card for sensory evaluation

1) Name of judge : …….
2) Date : ……
3) Replication No : ……....

SR. NO	CHAPTER	SAMPLE NO.						
		1	2	3	4	5	6	7
1	FLAVOUR (45)							
2	BODY AND TEXTURE (35)							
3	COLOUR AND APPERANCE (20)							
4	TOTAL (100)							

Remarks, If any:

Signature of the judge

The sample were graded based on the total score obtained as detailed below:-

Score	Graded
91 to 100	Excellence
89 to 91	Good
71 to 89	Fair
<70	Poor

3.7 Cost of Production : The production cost of paneer was worked out by using prevailing market rates of ingredients only.

3.8 Statistical Analysis : The data was tabulated and analyzed by employing Completely Randomized Design (CRD) using seven treatments with four replications as prescribed by Sheoran et al.(1998)

Plate 4. Sensory evaluation of paneer by panel of judges

CHAPTER IV

RESULTS AND DISCUSSION

The present consumption pattern of Indian consumer from milk to introduce new milk product brings a large scope for dairy processing in country. Dairy processing technologies in the area of milk and substitute of milk have to match the production of these perishable commodities to reach the consumers. It is great challenge to innovate methodologies and technologies at the same time encouraging the value addition in the milk products. Looking towards diversified benefit of nutritional value of different spices and buffalo milk, paneer was prepared from buffalo milk with different combination of spices. In present investigation the efforts have been made to find out the effect of blending of different spices with buffalo milk on quality of paneer.

The effect of different treatment combinations on physico-chemical properties of flavoured paneer viz. fat, protein, acidity, moisture, ash and sensory qualities and cost of production were studied. The results are presented and interpreted in this chapter.

4.1 Chemical composition

The buffalo milk used for paneer preparation was analyzed for its chemical composition and data is presented in Table 1

Table 1: Average chemical composition of buffalo milk

Sr.No.	Constituents	(%)
1.	Total Solids	15.45
2.	Moisture	84.55
3.	Fat	6.44
4.	Protein	3.82
5.	Ash	0.83
6.	Acidity	0.141

The data from Table 1 indicates that, the buffalo milk contained 15.45 percent total solids, 84.55 percent moisture, 6.44 percent fat, 3.82

percent protein, 0.83 percent ash and 0.141 percent acidity was used for preparation of paneer.

The above result of buffalo milk composition was in agreement wilth the results shown by De (2011) indicating the chemical composition of buffalo milk that is water, fat, protein, lactose and ash content were 84.2, 6.6. 3.9, 5.2 and 0.8 percent respectively.

Chorage (2016) stated chemical composition of buffalo milk was also in agreement with the data obtained having 15.53, 6.22, 3.87, 0.141 and 0.79 percent total solids, fat, protein, acidity and ash content respectively.

Table 2: Average chemical composition of cumin and blackpepper

Constituents	Cumin (%)	Blackpepper (%)
Protein	18	10.0
Fat	22	10.2
Ash	8	4.6
Acidity	0.58	0.42
Moisture	4	12

As noted by Parthasarathy et al. (2008) the average chemical composition of cumin and blackpepper is shown in Table 2.

Composition of cumin recorded in present investigation was more or less similar with Chadha (2006) who reported chemical composition of cumin as protein (17.7 percent), fat (23.8 percent), minerals (7.7 percent). While Nelson et al. (2011) reported proximate chemical composition of blackpepper as 10.9, 5.0, 11 percent of protein, ash and water respectively.

4.2 Sensory evaluation of paneer

Data in respect of sensory evaluation of paneer prepared from buffalo milk, different spices and their combination at different level of blending of buffalo milk with cumin and blackpepper powder are presented in following tables.

The assessment was done by studying the characteristics like colour and general appearance, body and texture, flavour and overall acceptability of the product by the panel of an average five judges by using “Hundread Point Hedonic Scale” score card.

4.2.1 Flavour of paneer

The data pertaining to flavour score of paneer prepared from buffalo milk, different spices and their combination are given in Table 3 and graphically represented in Figure 1

Table 3. Effect of different spices and their combinations on score of paneer flavour (Max. score 45)

Treatment	Combinations	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	40	22	40	41	35.75
T_2	0.2% Cumin	37	36	35	37	36.25
T_3	0.4% Cumin	43	43	43	42	42.75
T_4	0.2% Blackpepper	40	37	35	36	37.00
T_5	0.4% Blackpepper	42	44	43	43	43.00
T_6	0.2% Cumin+0.2% Blackpepper	39	38	37	40	38.50
T_7	0.4% Cumin+ 0.4% Blackpepper	44	43	43	43	43.25
F test						Sig
SE (M)±						1.819
CD at 5%						5.386

The treatment T_7, T_5, and T_3 was significantly superior over the T_6, T_4, T_2 and T_1 treatments whereas treatment T_7 is at par with T_6, T_5 and T_3 treatment.

It was observed from above findings that the mixing of buffalo milk with different spices and their combinations in various proportions was produce good quality paneer to increased upto 0.4 percent of spices mixing

with buffalo milk. This might be due to pleasant flavour of spices and acceptability of paneer in T_7 treatment.

The obtained results was in close agreement with Omer (2014) that flavour score of soft white cheese increased with addition of cumin oil.

The results obtained in present investigation was in agreement with Anju Boora Khatkar et al.(2017) suggested that flavour score of paneer increased with addition of cinnamon spice.

Above result was in agreement with the result showed by Himabindu and Arunkumar (2017) indicating that score for flavour of cottage cheese blended with spice was increased with addition of black pepper.

4.2.2 Body and texture of paneer

Score for body and texture of paneer prepared under different treatments is tabulated in Table 4 and graphically represented in Figure 2

Table 4. Effect of different spices and their combinations on score of paneer body and texture (Max. score 35)

Treatment	Combinations	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	30	30	30	30	30.00
T_2	0.2% Cumin	30	31	30	31	30.50
T_3	0.4% Cumin	31	33	32	32	32.00
T_4	0.2% Blackpepper	30	31	31	31	30.75
T_5	0.4% Blackpepper	33	33	33	32	32.75
T_6	0.2% Cumin+0.2% Blackpepper	29	33	33	32	31.75
T_7	0.4% Cumin+ 0.4% Blackpepper	33	34	34	33	33.50
F test						Sig
SE (M)±						0.440
CD at 5%						1.302

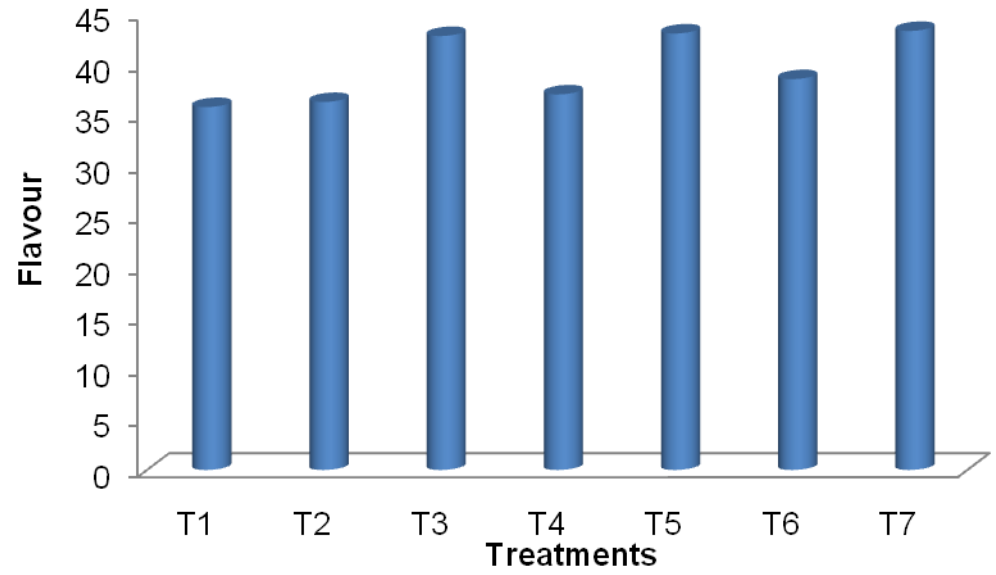


Fig. 1. Effect of different spices and their combinations on score of paneer flavour (Max. score 45)

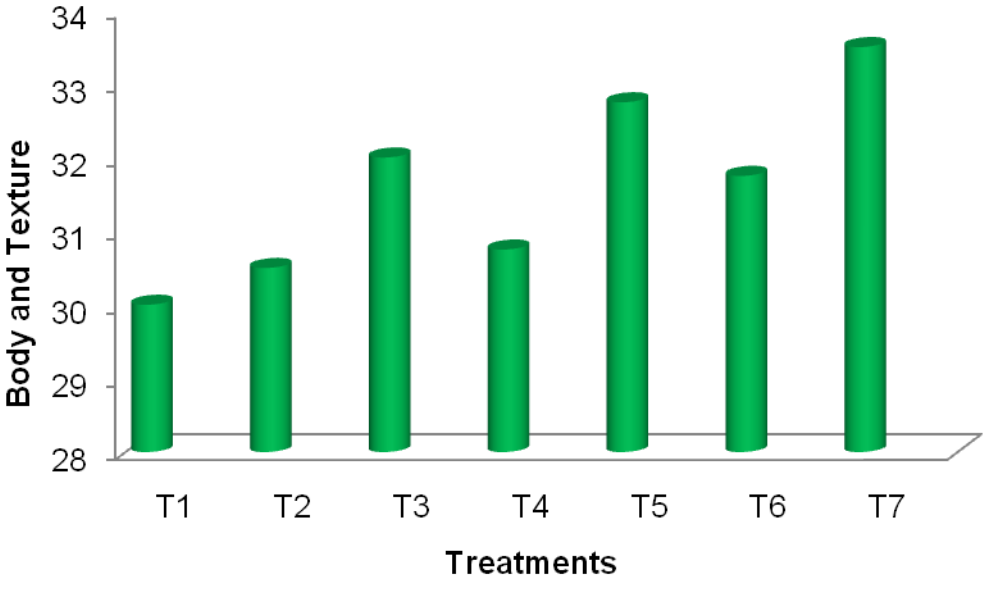


Fig. 2. Effect of different spices and their combinations on score of paneer body and texture (Max. score 35)

It is revealed from Table 4 that, average body and texture score for buffalo milk paneer (T_1) was 30.00, whereas, average score for mixing of different spices and their combinations in the treatments T_2, T_3, T_4, T_5, T_6 and T_7 were 30.50, 32.00, 30.75, 32.75, 31.75 and 33.50 percent respectively.

The body and texture of paneer in treatment T_7, T_5 and T_3 was significantly superior over T_6, T_4, T_2 and T_1. Treatment T_7 was at par with T_5 and T_3.

It showed that mixing of buffalo milk with different spices in combinations and individually in T_7 was found like very much.

The result observed in above investigaton for body and texture is more or less similar to result showed by Anju Boora Khatkar et al. (2017) that body and texture of paneer increased with addition of cinnamon spice.

The result obtained was in agreement with Himabindu and Arunkumar (2017) who suggested score for body and texture of cottage cheese blended with spice was increased with addition of blackpepper.

4.2.3 Colour and appearance of paneer

Observations regarded in respect to score of colour and appearance of paneer prepared from buffalo milk blended with different spices and their combination are presented in Table 5 and graphically represented in Figure 3.

It is observed from table 5 that paneer prepared from buffalo milk and mixing with different spices and their combinations in treatment T_7 was found like very much. The average score for colour and appearance of different paneer were 16.50, 17.00, 18.00, 17.25, 18.25, 17.50 and 18.50 for treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_7 respectively. The highest score of colour and appearance was obtained in T_7 while, lowest in treatment T_1.

The treatment T_7, T_5 and T_3 were significantly superior over T_6, T_4, T_2 and T_1 treatments. The result indicated that significant effect of

proportion of spices with buffalo milk on colour and appearance of paneer. While treatment T_7 was at par with treatment T_6, T_5 and T_3.

Table 5. Effect of different spices and their combinations on score of Paneer colour and appearance (Max. score 20)

Treatment	Combinations	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	16	16	17	17	16.50
T_2	0.2% Cumin	17	18	17	16	17.00
T_3	0.4% Cumin	18	19	17	18	18.00
T_4	0.2% Blackpepper	16	18	18	17	17.25
T_5	0.4% Blackpepper	18	18	19	18	18.25
T_6	0.2% Cumin+0.2% Blackpepper	17	18	18	17	17.50
T_7	0.4% Cumin+ 0.4% Blackpepper	18	19	19	18	18.50
F test						Sig
SE (M)±						0.354
CD at 5%						1.047

The obtained results was in close agreement with Omer (2014) that colour and appearance score of soft white cheese increased with addition of cumin oil.

The result observed in present investigstion was in close agreement with Shweta Buch et al. (2014) reported that the score for colour and appearance of paneer increased with addition of turmeric.

The above results are in agreement with Himabindu and Arunkumar (2017) who reported that the score for colour and appearance cottage cheese blended with spice was increased with addition blackpepper.

4.2.4 Overall acceptability of paneer

The score observed for overall acceptability of paneer prepared under different treatments was tabulated in Table 6 and graphically represented in Figure 4.

Table 6. Effect of different spices and their combinations on score of Paneer overall acceptability (Max. score 100)

Treatment	Constituents	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	89	68	87	87	82.75
T_2	0.2% Cumin	87	85	85	83	85.00
T_3	0.4% Cumin	93	93	93	92	92.75
T_4	0.2% Blackpepper	86	85	88	82	85.25
T_5	0.4% Blackpepper	94	95	92	95	94.00
T_6	0.2% Cumin+0.2% Blackpepper	88	88	85	81	85.50
T_7	0.4% Cumin+ 0.4% Blackpepper	96	95	95	95	95.25
F test						Sig
SE (M)±						2.070
CD at 5%						6.129

It is revealed from Table 6, that paneer prepared from buffalo milk (T_1) and blending of buffalo milk with different spices individually and in combinations while T_7 was found like very much. The score of overall acceptability of paneer were 82.75, 85.00, 92.75, 85.25, 94.00, 85.50 and 95.25 for treatments T_1, T_2, T_3, T_4, T_5, T_6 and T_7 respectively. The treatment T_7, T_5 and T_3 showed highest overall acceptability score while treatment T_5 showed lowest score.

The treatment T_7, T_5 and T_3 was significantly superior over the T_6, T_3, T_2 and T_1 treatments. The treatment T_7 is at par with T_5 and T_3 treatment. The overall acceptability depends upon the score at flavour,

body and texture and appearance, all these attributes increased in treatment T_7, T_5 and T_3.

The above results was in agreement with results showed by Anju Khatkar et al. (2017) that the score for overall acceptability of paneer increased with the addition of cinnamon spice.

The obtained results was in agreement with Himabindu and Arunkumar (2017) who reported that the score for overall acceptability of cottage cheese blended with spices was increased with addition of blackpepper.

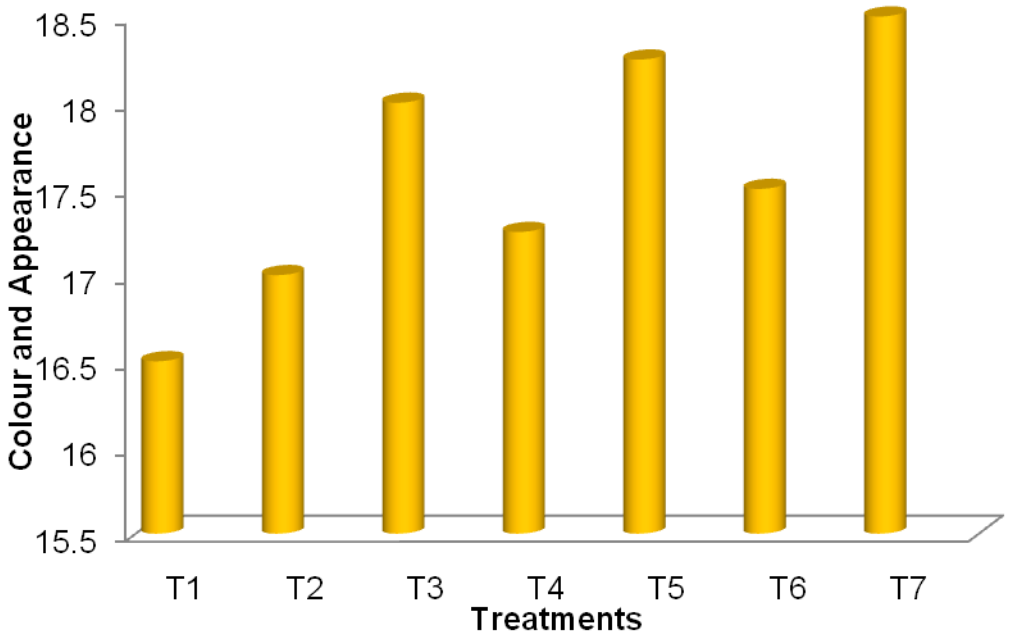


Fig.3. Effect of different spices and their combinations on score of paneer colour and appearance (Max. score 20)

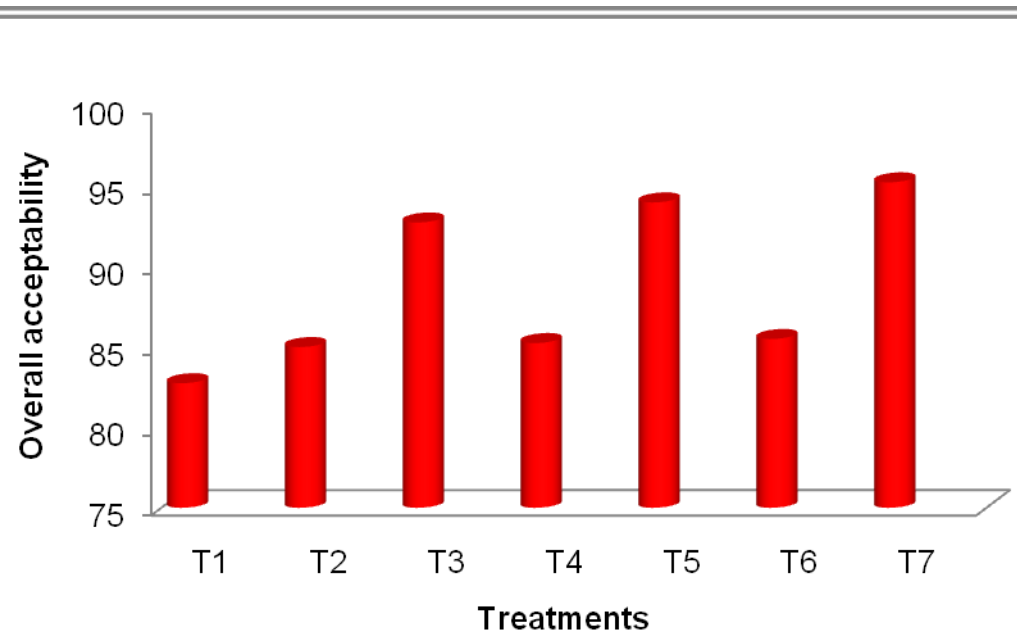


Fig. 4. Effect of different spices and their combinations on score of paneer overall acceptability (Max. score 100)

4.3 Fat content in paneer

Observations regarding fat content of paneer prepared from buffalo milk by addition of different spices and their combination is presented in Table 7 and graphically represented in Figure 5

Table 7. Effect of different spices and their combinations on fat content of Paneer

Treatment	Composition	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	25.00	24.99	25.01	25.00	25.000
T_2	0.2% Cumin	25.00	25.00	24.98	24.99	24.993
T_3	0.4% Cumin	24.98	24.99	24.99	24.99	24.988
T_4	0.2% Blackpepper	24.97	24.96	24.98	24.97	24.970
T_5	0.4% Blackpepper	24.93	24.95	24.94	24.94	24.940
T_6	0.2% Cumin+ 0.2% Blackpepper	24.96	24.97	24.97	24.95	24.963
T_7	0.4% Cumin+ 0.4% Blackpepper	24.93	24.92	24.93	24.93	24.928
F test						Sig
SE (M)±						0.004
CD at 5%						0.012

The perusal of data from Table 7 revealed that addition of different spices and their combinations had significantly affected the fat content of paneer.It was observed that addition of spices and their combinations decreased the fat content of paneer. The declining trend of fat content of paneer can be attributed to the fact that the fat content of cumin is little higher (22 percent) than blackpepper (10.2 percent), both values are much lower than that plain paneer (25.00 percent)

The decrease in fat content of paneer was more in T_5 was 24.940 percent as compared to T3 was 24.988 percent

The above results was in agreement with result reported by Priya Mishra (2013) that with addition of different spices fat content of paneer decreased.

Mrunali Mhatre (2018) reported that fat content of paneer decreased with addition of ginger juice which is similar to above obtained results.

4.4 Protein content in paneer

The protein content of paneer prepared under different treatments is tabulated in Table 8 and graphically represented in Figure 6

Table 8 . Effect of different spices and their combinations on protein content of paneer

Treatment	Composition	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	16.25	16.24	16.24	16.23	16.240
T_2	0.2% Cumin	16.24	16.25	16.23	16.25	16.243
T_3	0.4% Cumin	16.25	16.24	16.25	16.24	16.245
T_4	0.2% Blackpepper	16.21	16.20	16.21	16.21	16.208
T_5	0.4% Blackpepper	16.22	16.21	16.22	16.21	16.215
T_6	0.2% Cumin+0.2% Blackpepper	16.24	16.23	16.22	16.23	16.230
T_7	0.4% Cumin+ 0.4% Blackpepper	16.22	16.22	16.23	16.22	16.223
F test						Sig
SE (M)±						0.003
CD at 5%						0.010

It is revealed from Table 8 that, mean protein percent of paneer prepared from buffalo milk (T_1) was 16.240 and buffalo milk blended with different spices and their combinations were 16.243, 16.245,

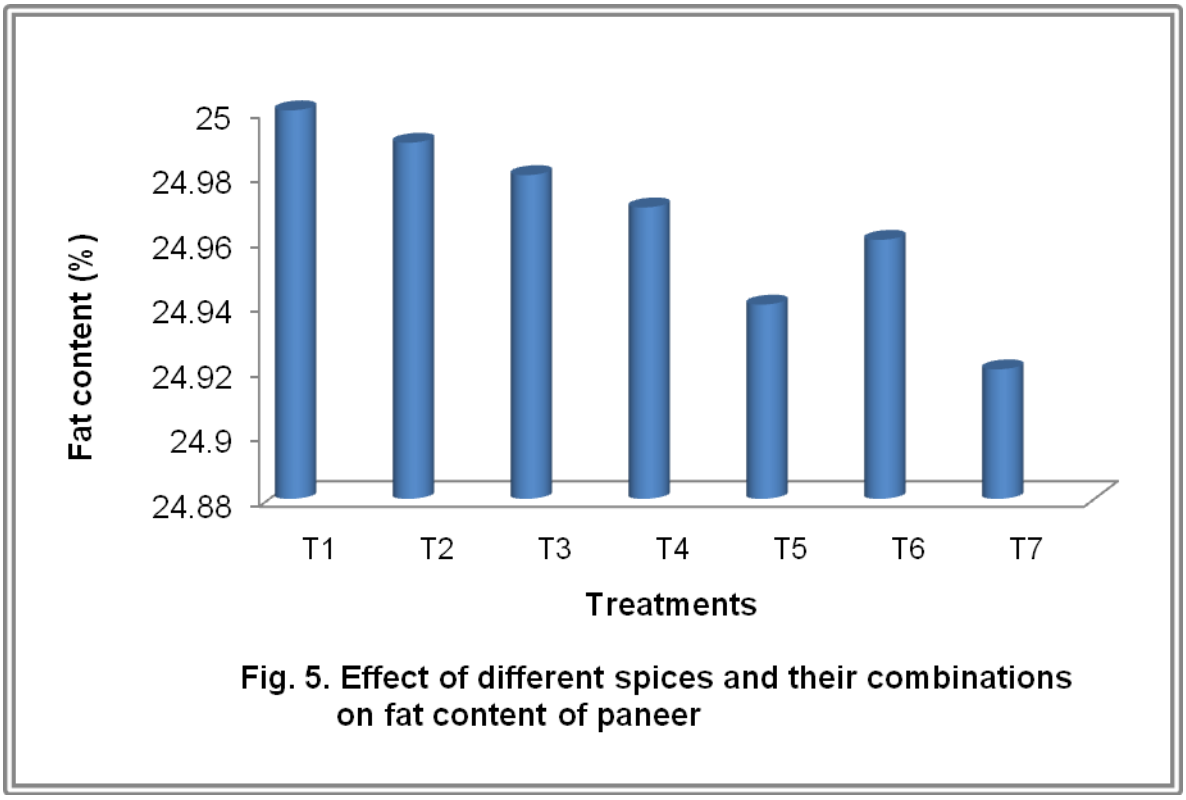


Fig. 5. Effect of different spices and their combinations on fat content of paneer

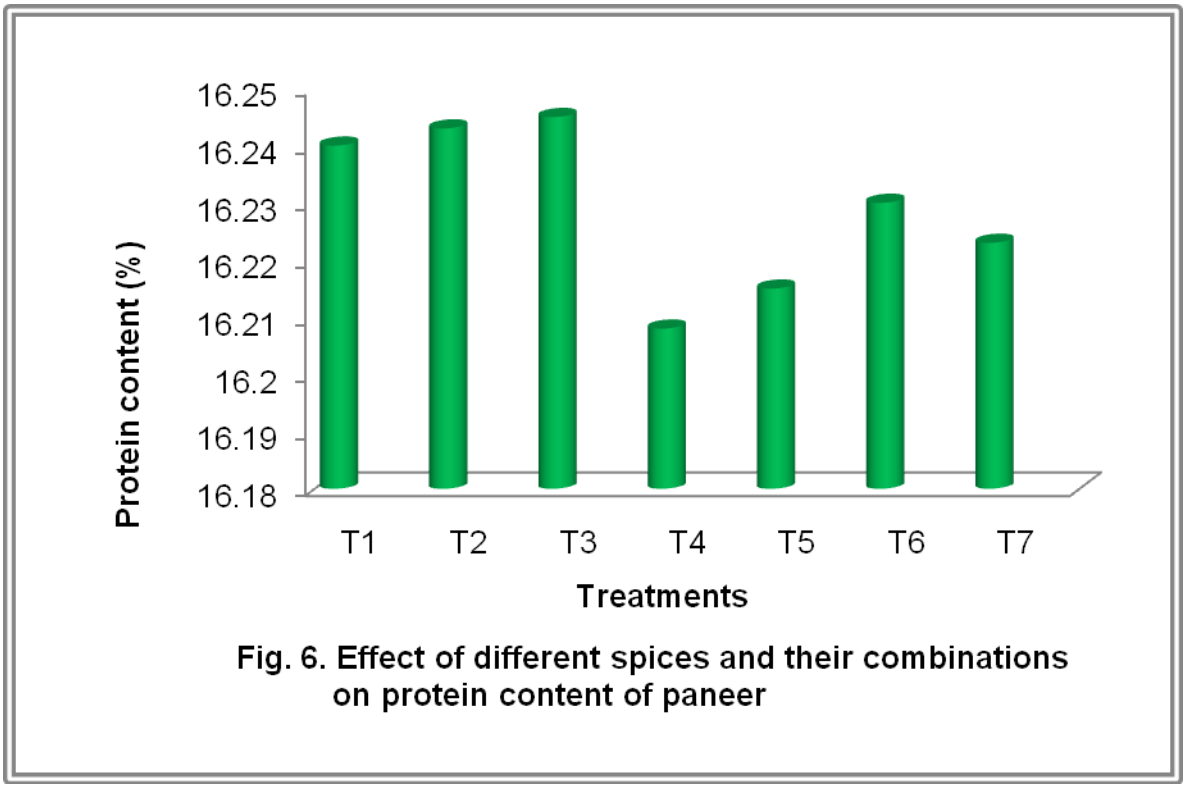


Fig. 6. Effect of different spices and their combinations on protein content of paneer

16.208, 16.215, 16.230 and 16.223 percent in treatment T_2, T_3, T_4, T_5, T_6 and T_7 respectively. Treatment T_3 was significantly superior over rest of the treatments.

It indicated that, as proportion of cumin spice with buffalo milk increased, the protein content of paneer also increased as cumin contain 18.00 percent protein. While blackpepper spice proportion showed declining trend on protein content of paneer as it contain 10.00 percent protein.

The treatment T_3 was significantly superior over rest of the treatments. The treatment T_3 is at par with T_2 and T_1.

These results were in agreement with the results reported by Monika Rani et al. (2014) stated that protein content of paneer increased with the addition of diiferent spices with milk.

The results obtained in present investigation was in agreement with results obtained by Priya Mishra (2013) that with addition of different spices protein content of paneer increased with addition of different spices.

The obtained results was in close agreement with Omer (2014) reported that protein content of soft white cheese increased with the addition of cumin oil.

The above results was in agreement with Richa Badola et al.(2018) observed that the protein content of paneer is slightly decreased with the addition of blackpepper and cardamom.

4.5 Total solids content of paneer

Observations recorded for total solids content of paneer prepared from buffalo milk blended with cumin, blackpepper and combination of it in different proportion is given in Table 9 and graphically represented in figure 7

Table 9. Effect of different spices and their combination on total solids content of paneer

Treatment	Combinations	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	48.51	48.50	48.51	48.52	48.51
T_2	0.2% cumin	48.60	48.59	48.60	48.61	48.60
T_3	0.4% cumin	48.71	48.70	48.71	48.72	48.71
T_4	0.2% Blackpepper	48.58	48.57	48.58	48.59	48.58
T_5	0.4% Blackpepper	48.66	48.65	48.66	48.67	48.66
T_6	0.2% cumin+0.2% Blackpepper	48.68	48.67	48.68	48.69	48.68
T_7	0.4% cumin+ 0.4% blackpepper	48.85	48.84	48.86	48.85	48.85
F test						Sig
SE (M)±						0.003
CD at 5%						0.008

The results in Table 9 showed that, average total solids content of paneer prepared from buffalo milk (T_1) was 48.510 percent. The total solid content in blending of buffalo milk with different spices and their combinations in treatments T_2, T_3, T_4, T_5, T_6 and T_7 were 48.604, 48.715, 48.588, 48.667, 48.683 and 48.857 percent respectively.

The effect of proportion of blending of buffalo milk with different spices and their combinations on total solid content in paneer was observed significant effect. Treatment T_7 was significant superior over other treatments.

Result observed in present investigation was in aggrement with result reported by Omer (2014) that as addition of cumin oil in Sudanese white cheese during ripening increased the total solids content of the product.

The above results was in agreement with Monika Rani et al.(2014) reported that with the addition of different spices total solids content of paneer decreased.

4.7 Titratable acidity of paneer

The observations of acidity in paneer prepared from buffalo milk with addition of different spices and their combination in different proportion are tabulated in Table 10 and graphically represented in Fig. 8

Table 10. Effect of different spices and their combinations on Titratable acidity of Paneer

Treatment	Composition	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	0.50	0.51	0.49	0.50	0.500
T_2	0.2% Cumin	0.49	0.50	0.50	0.50	0.498
T_3	0.4% Cumin	0.50	0.49	0.50	0.49	0.495
T_4	0.2% Blackpepper	0.50	0.49	0.50	0.49	0.495
T_5	0.4% Blackpepper	0.49	0.49	0.50	0.49	0.493
T_6	0.2% Cumin+0.2% Blackpepper	0.49	0.50	0.50	0.50	0.498
T_7	0.4% Cumin+ 0.4% Blackpepper	0.50	0.49	0.50	0.49	0.495
F test						NS
SE (M)±						0.003
CD at 5%						-

It is revealed from Table that, average acidity was 0.500 percent in buffalo milk paneer (T_1) while acidity content inblended paneer were 0.498, 0.495, 0.495, 0.493, 0.498 and 0.495 percent in treatments T_2, T_3, T_4, T_5, T_6 and T_7 respectively. Treatment T_5 (0.493 %) showed lowest acidity than T_1, T_2, T_3, T_4, T_6 and T_7 treatments.

The result observed in present investigstion on titrable acidity was in close agreement with reported by Shweta Buch et al. (2014) that decrease in titrable acidity of paneer with increase in level of turmeric.

The results obtained was in agreement with Himabindu et al. (2017) who suggested that there is slightly decrease in titratable acidity of

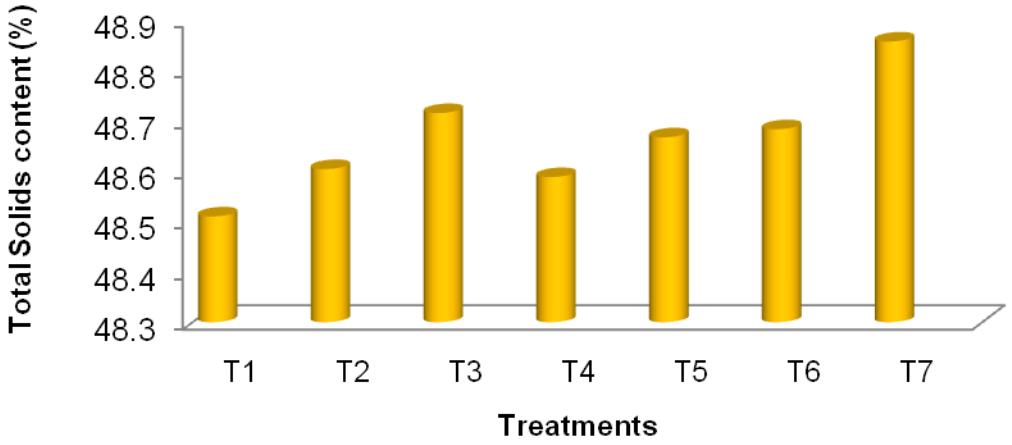


Fig. 7. Effect of different spices and their combination on total solids content of paneer

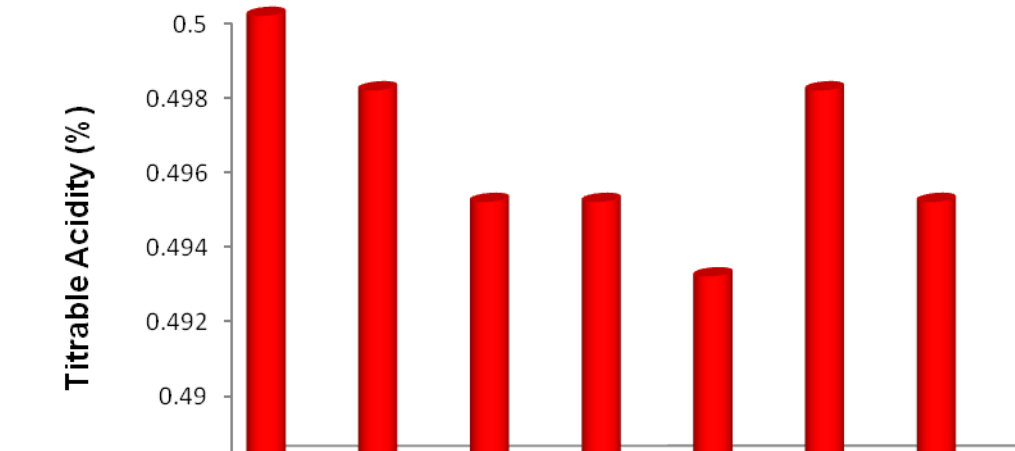


Fig.8. Effect of different spices and their combinations on Titrable acidity of paneer

cottage cheese blended with spice was increased with addition of blackpepper.

The obtained results was in agreement with Mrunali Mhatre (2018) who stated that there is slightly decreased in titrable acidity with the addition of ginger juice in paneer.

4.5 Ash content of paneer

Observations recorded on ash content of paneer prepared from blending of buffalo milk with cumin, blackpepper powder and their combinations were tabulated in Table 11 and graphically represented in Figure 9

Table 11. Effect of different spices and their combinations on ash content of Paneer (% Dry matter basis)

Treatment	Composition	Scores and Number of replication				Mean
		I	II	III	IV	
T_1	Control	1.71	1.72	1.70	1.71	1.710
T_2	0.2% Cumin	1.72	1.72	1.73	1.72	1.723
T_3	0.4% Cumin	1.73	1.74	1.73	1.74	1.735
T_4	0.2% Blackpepper	1.71	1.72	1.71	1.72	1.715
T_5	0.4% Blackpepper	1.72	1.73	1.72	1.72	1.723
T_6	0.2% Cumin+0.2% Blackpepper	1.83	1.82	1.83	1.83	1.828
T_7	0.4% Cumin+ 0.4% Blackpepper	1.74	1.75	1.74	1.75	1.745
F test						Sig
SE (M)±						0.003
CD at 5%						0.009

It is observed from Table 11 that, average ash was 1.710 ercent for buffalo milk paneer (T_1) while blends of buffalo milk with different spices and their combinations ash percentage was 1.723, 1.735, 1.715, 1.723, 1.828 and 1.745 percent in treatment T_2, T_3, T_4, T_5, T_6 and T_7 respectively. The effect of proportion of different spices and their combinations with

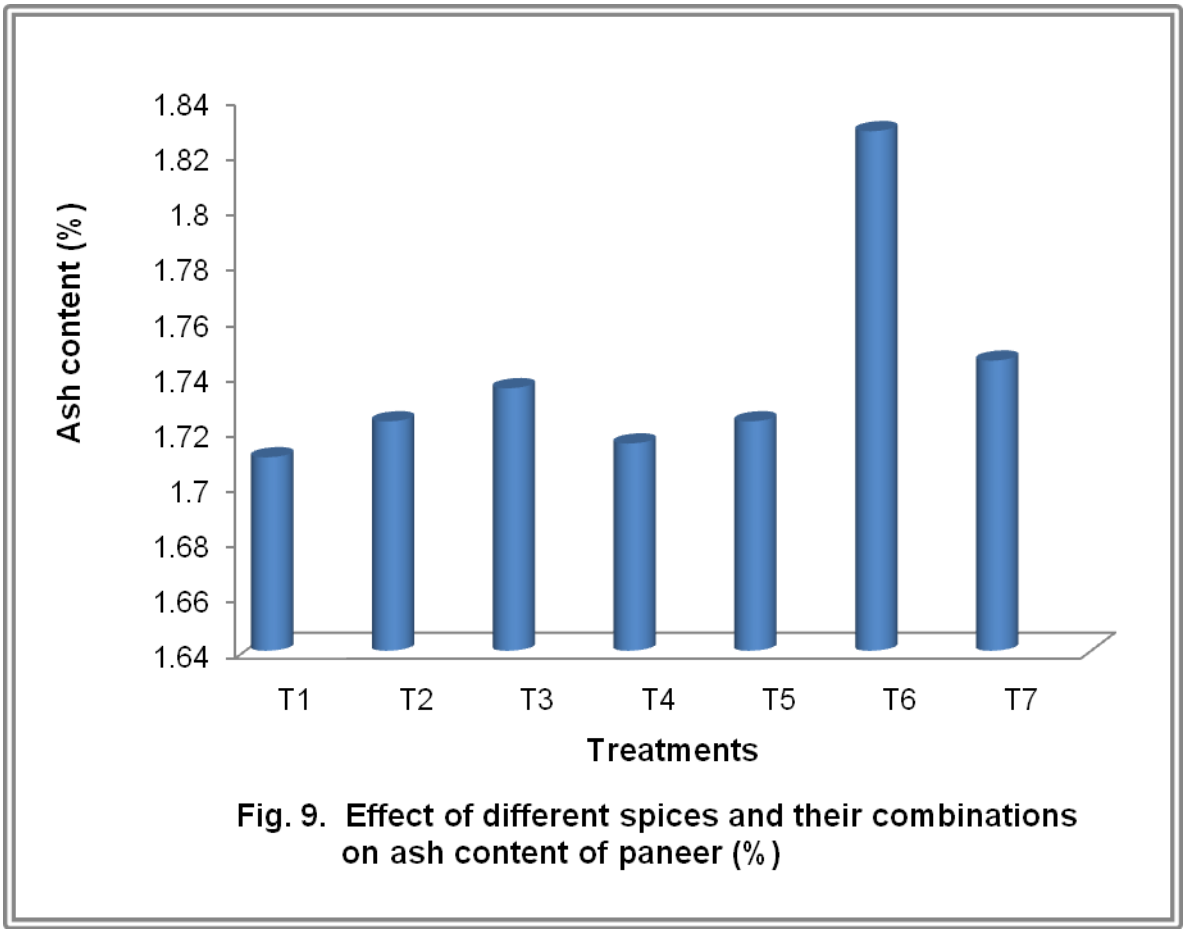


Fig. 9. Effect of different spices and their combinations on ash content of paneer (%)

buffalo milk for making paneer was observed significant. The treatment T5 was significantly superior over treatments T_1,T_2, T_3, T_4, T_6 and T_7

It was observed that the ash content show gradual increase with increase in the level of different spices and their combinations. The increasing trend of ash percent in paneer was more in cumin (8 percent) as compare to blackpepper (4.6 percent). While ash content in paneer (1.71 percent)

These results was in agreement with the results obtained by Monika Rani et al. (2014) stated that ash content of paneer increased with addition of different spices.

Result observed in present investigation was in aggrement with result reported by Omer (2014) that as addition of cumin oil in Sudanese white cheese during ripening increased the ash content of the product.

Mrunali Mhatre (2018) showed that ash content of panner increased with addition of ginger juice in paneer which is similar to above obtained results.

4.8 Cost structure of flavoured paneer

Cost of paneer prepared from buffalo milk blended with cumin, blackpepper powder and their combinations was worked out and is presented in Table 12.

While estimating the cost of the finished product, the cost of the ingredients used for preparation of paneer was rated as per the prevailing market price. In addition to fuel cost, miscellaneous cost and the labour charges @ 10 percent of the total cost of production were also taken into consideration.

The cost of production of paneer from buffalo milk blended with different spices and their combinations for treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_7 were Rs. 260.075, 260.675, 261.275, 262.275, 264.475, 262.875 and 2645.675 respectively.

Table 12. Estimation of cost structure of one kg paneer production from buffalo milk blended with cumin, black pepper powder and their combination

Sr. No.	Particular	T_1	T_2	T_3	T_4	T_5	T_6	T_7
1	**Ingredients used**							
a.	Buffalo milk(ml)	1000	1000	1000	1000	1000	1000	1000
b.	Cumin (gm)	00	0.4	0.8	00	00	0.4	0.8
c.	Blackpepeer (gm)	00	00	00	0.4	0.8	0.4	0.8
d.	Citric acid (gm)	2	2	2	2	2	2	2
e.	Salt (gm)	5	5	5	5	5	5	5
2.	**Cost**							
a.	Buffalo milk @ Rs./lit	40	40	40	40	40	40	40
b.	Cumin (Rs.15/50gm)	00	0.12	0.24	00	00	0.12	0.24
c.	Blackpepper (Rs.55/50gm)	00	00	00	0.44	0.88	0.44	0.88
d.	Salt (Rs.19/kg)	0.095	0.095	0.095	0.095	0.095	0.095	0.095
3.	Cost of coagulant citric acid @ (Rs.96/100gm)	1.92	1.92	1.92	1.92	1.92	1.92	1.92
4.	Cost of processing (i.e. utensil, handling,labour etc.) (Rs.)	10	10	10	10	10	10	10
5.	**Total cost of production of paneer(Rs)**	52.015	52.135	52.255	52.455	52.895	52.575	53.135
6.	Quantity of paneer obtained (g)	200	200	200	200	200	200	200
7.	Cost of production of 1 kg paneer (Rs.)	260.075	260.675	261.275	262.275	264.475	262.875	265.675

The cost of production of paneer was slightly varies with addition of spices i.e. cumin and blackpepper. But overall change in cost of production was non significant these may be due to use of very small quantity of cumin and blackpepper in paneer. These slight increase in rate of paneer can be compensated with value addition in tasted flavour and aggregate value of spices.

These observations were supported by some research workers as,

Mrunali Mhatre (2018) calculated that incorporation of ginger juice in paneer manufacturing resulted in considerable increase in the cost of production comparable to control paneer.

Desale (2012) concluded that the cost of production of paneer with addition of different preservatives viz., black pepper, cardamom, clove, black pepper + clove, black pepper + cardamom and clove + cardamom to enhance shelf life of paneer is slightly increased per kg of paneer.

CHAPTER V

SUMMARY AND CONCLUSION

Paneer is an important nutritious and whole some indigenous dairy product, which occupy a prominent place among traditional milk products and carry lot of market potential. It is of great value in diet. Paneer is used as base material for the preparation of large number of culinary dishes and it is a popular food product at the household as well as ever increasing organized food chains.

Now a days, use of spices in paneer is getting a good footing especially as a novelty product. Paneer incorporated with cumin and blackpepper powder enriches and enhances its quality as well as appealing colour and pleasing flavour to the product.

Cumin and blackpepper, being a major spice, has many uses in the food as flavouring and medicinal product. In the present investigation, attempts were made to explore the possibility of popularizing the product with addition of cumin and blackpepper powder and their combinations as well as to standardize the technique of paneer preparation blended with cumin and blackpepper powder and their combinations.

The present investigation entitled “Preparation of flavoured paneer” was undertaken with a view to standardize the technique for preparation of paneer utilizing buffalo milk, cumin and blackpepper powder and their combination

The investigation was carried out in the Department of Animal Husbandry and Dairy Science, Dr.PDKV, Akola. The paneer prepared with following treatments:

T_1 = control

T_2 = 0.2 % cumin powder

T_3 = 0.4 % cumin powder

T_4 = 0.2 % blackpepper powder

T_5 = 0.4 % blackpepper powder

T_6 = 0.2 % cumin powder + 0.2 % blackpepper powder

T_7 = 0.4 % cumin powder + 0.4 % blackpepper powder

Paneer was analyzed for its chemical quality attributes viz., total solids, fat, protein, ash and titratable acidity. Sensory quality of product was judged for colour and general appearance, body and texture, flavour and overall acceptability. The cost of economics was worked out by taking into account the prevailing market prices of the ingredients. The statistical analysis was carried out using Completely Randomized Design with seven treatments and four replications. The results of present investigation are summarized in the following paragraphs.

5.1 Sensory evaluation of paneer

5.1.1 Flavour

The score for flavour, the treatment T_7 (43.250) was significantly superior followed by T_5 (43.00) and T_3 (42.75) among the rest of the treatments. The treatment T_7 was at par with T_6, T_5 and T_3 treatments.

5.1.2 Body and texture

The mean score of body and texture, treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_7 were 30.00, 30.50, 32.00, 30.75, 32.75, 31.75 and 33.50 respectively. Treatment T_7 (33.50) was significantly superior followed by T_5 (32.75), and T_3 (32.00) over rest of the treatments T_6, T_4, T_2 and T_1

5.1.3 Colour and appearance

The score for colour and appearance for treatment T_7 score highest followed by T_5, T_3, T_6, T_4, T_2 and T_1. Treatment T_7 (18.50) was significantly superior followed by T_5 (18.25) and T_3 (18.00) over the rest of the treatments.

5.1.4 Overall acceptability

The overall acceptability is the cumulative effect of all the sensory evaluation parameter and it was notably higher for treatment T_7 (95.25) followed by T_5 (94.00) and T_3 (92.75). Lowest score was observed as 82.75 for treatment T_1. The treatment T_7, showed highest overall

acceptability score followed by T_5 and T_3 while treatment T_1 showed lowest one.

5.2 Chemical composition of paneer

5.2.1 Fat

The fat content of paneer for different treatments varied from 24.928 to 25.00 percent. The mean fat content of treatmentsT_1, T_2, T_3, T_4, T_5, T_6 and T_7 was 25.00, 24.993, 24.988, 24.97, 24.94, 24.963 and 24.928 percent respectively

5.2.2 Protein

The protein content of paneer was highest as (16.245) percent for treatment T_3 and lowest as (16.208) for treatment T_4. The treatment T_3 was significantly superior over rest of the treatments. The treatment T_3 is at par with T_2 and T_1

5.2.3 Total Solids

The total solids content of treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_7 were 48.51, 48.604, 48.715, 48.588, 48.667, 48.683 and 48.857 respectively. The total solids content of paneer was highest in T_7 (48.857 percent) and lowest in T_1 (48.51 percent). The treatment T_7 (48.857 percent) was significantly superior over the other treatments.

5.2.4 Ash

The ash content in paneer was varied from 1.71 to 1.828 percent. The highest ash in paneer was recorded for treatment T_6 (1.828 percent). The ash of paneer increased with increasing level of cumin , blackpepper powder and their combinations at various level.

5.2.5 Titrable Acidity

The acidity content was varied from T_1 to T_7. The average acidity was 0.50 percent in buffalo milk paneer (T_1) while acidity content in blended paneer were 0.498, 0.495, 0.495,0.493, 0.498 and 0.495 percent in treatments T_2, T_3, T_4, T_5, T_6 and T_7. The treatment T_5 showed lowest acidity over the rest of the treatments.

5.3 Cost structure of flavoured paneer

The cost of production of paneer for treatments T_1, T_2, T_3, T_4, T_5, T_6 and T_7 were Rs. 260.075, 260.675, 261.275, 262.275, 264.475, 262.875 and 265.675 Rs. per kg respectively. The treatment T_7 was most acceptable by jugdes followed by T_5 and T_3 treatments .

CONCLUSIONS

1. From the result of present investigation, it is concluded that highest overall acceptability score was obtain from buffalo milk paneer however, the panel of judges also accepted for T_7 followed by T_5 and T_3 treatments.
2. Chemical analysis of paneer showed that, protein, total solids and ash in paneer increased while fat content was decreased with increased level of cumin, blackpepper powder and their combinations.
3. The cost of paneer was slightly increased i.e. Rs. 260.075 (T_1) to 265.675 (T_7) by blending of cumin, blackpepper powder and their combinations in different proportion for preparation of paneer which can be compensated with the flavour of the product.

CHAPTER VI

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APPENDIX I

Score card for evaluating sensory quality of flavoured paneer prepared from buffalo milk by addition of cumin and black pepper powder and their combinations as per treatment.

1) Name of judge: ……
2) Date : ……
3) Replication No: ……..

SR. NO	CHARACTER	TREATMENT NO.						
		1	2	3	4	5	6	7
1	FLAVOUR (45)							
2	BODY AND TEXTURE (35)							
3	COLOUR AND APPERANCE (20)							
4	TOTAL (100)							

(Pal and Gupta,1985)

Remarks, If any:

Signature of the judge

The sample were graded based on the total score obtained as detailed below:-

Score	**Graded**
91 to 100	Excellence
89 to 91	Good
71 to 89	Fair
<70	Poor