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Development Of Moringa Oleifera Incorporated Panner And Its Sensory Evaluation

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ABSTRACT

The present study was undertaken to explore the antimicrobial and antioxidant properties of Moringa leaf in enhancing the shelf-life of paneer. Paneer is an important heat and acid coagulated milk product. It is a rich source of high-quality animal protein, fat, minerals, and vitamins. It is a non-fermentative, non-renneted, non-melting and unripened type of cheese. Therefore, paneer fortified with 0.5%, 1%, and 1.5% of Moringa leaf extracts of along with control was studied to explore the potency of these herbs on oxidative stability and storage quality of paneer on 7, 14, and 28 days in refrigerated (24±1ºC) condition. Paneer prepared with 0.5% of Moringa leaf were adjudged to the best among all based on sensory attributes. Paneer incorporated with Moringa leaf were safe for consumption till 28 days at refrigerated storage (44±10C) based on pH, moisture, fat, protein, energy, iron etc.., microbiological profile and sensory evaluation of paneer. The developed value-added paneer could be conveniently packed in LDPE for a period of 28 days in refrigerated (24±1ºC) condition without any marked loss of chemical, microbial and sensory quality.

Keywords: Moringa leaf powder, Paneer, oxidative stability, microbiological evaluation, sensory.

INTRODUCTION

Milks and dairy products are highly nutritious and plays vital role in human diets for both children and adults. The composition of milk varies according to the animal from which it comes, assisting for required rate of growth and development of the young ones of that species. Thus, for human infants, human milk is better than cows' milk or any other milk product. Exclusive breastfeeding without other foods or liquids is the optimum means of feeding for the first six months of an infant's life. Continuing breast feeding for many more months is of great value, while the baby is introduced to other

foods. If breast milk remains an important food for the child into the second or even third year of life, then animal milk is not necessary in the child's diet.

Casein and whey proteins are of high biological value, are the most important constituents of cows' milk. The carbohydrate in cows' milk is disaccharide lactose. Fat is present as very fine globules, which on standing tend to coalesce and rise to the surface as cream layer. The fat has a rather high content of saturated fatty acids.

The calcium content of cows' milk (120 mg per 100 ml) is four times that of human milk (30 mg per 100 ml). When a human infant is fed entirely on cows' milk. The excess calcium does no good but causes no harm.

Milk is also a very good source of riboflavin and vitamin A. It is a fair source of thiamine and vitamin C, but it is a poor source of iron and niacin.

Paneer is an important indigenous milk product which is obtained by heating the milk followed by acid coagulation by using suitable coagulant such as citric acid, lactic acid, tartaric acid, sour whey. The whey is removed to some extent through filtration and pressing. Paneer is a non-fermentative, non-renneted and non-melting type of cheese, obtained by acid and heat coagulation of milk. It is considered one of the most extensively consumed dairy product in India.

The paneer market in India reached a value of INR 365.5 billion in 2020. Looking forward, IMARC Group expects the market to grow at a CAGR of 15% during 2021-2026. According to the PFA (2010), paneer means product obtained from cow or buffalo milk or combination thereof, by the precipitation with sour milk, lactic acid, or citric acid. It shall contain no more than 70 percent moisture and the fat content should not be less than 50 percent expressed on dry matter. Milk solids may also be used in preparation of paneer.

Bureau of Indian standards (BIS 1983) imposed maximum of 60 percent moisture and minimum of 50 percent fat in dry matter for paneer. Good quality paneer is characterized by a marble white colour, mildly acidic taste, sweetish, nutty flavour, and spongy body, closely knit and smooth texture. (Aneja, 2007)

Paneer is of great value in diet, especially in the Indian vegetarian context, because it contains a high level of fat and proteins as well as some minerals, especially calcium and phosphorous. It is also high level of fat-soluble vitamins A and D. 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). Paneer is mainly used as base material in preparation of various dishes like potatoes, peas, and spinach etc.

Moringa oleifera is the most widely cultivated species of a monogenetic family, the Morinaga, that is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh, and Afghanistan. Moringa oleifera is an Angiosperm plant commonly known as the ‘drumstick’ or ‘horseradish’ tree. It belongs to genus Moringa having 13 different species. Among them, Moringa oleifera is the most widely cultivated species native to tropical and sub-tropical region of world. Moringa oleifera is a tropical deciduous perennial dicotyledonous tree. It has different names in different countries like “Shiferaw” in Ethiopia and drumstick tree or horseradish tree in India and ‘Sitalchini’, Munga, Sahijan or Saijan in Nepal.

It Is a small, graceful, deciduous tree with sparse foliage, belonging to family Moringaceae. The tree ranges from 5 to 10m in height. The Leaves are alternate, the old ones soon fall off and each leaf large up to about 90 cm long, with opposite pinnae. They are 5cm away from the central stalk of the plant. Moringa contains slightly larger terminal leaflets with leaflets in opposite pairs. Leaflets are dark green above and pale on the under surface and variable in size and shape, but often rounded-elliptic, as much as 2.5 cm long.

Flowers are produced throughout the year, in loose axillary panicles up to 15cm long. Fruit large and distinctive, up to 90 cm long and 12 mm broad, slightly constricted at intervals, gradually tapering to a point, 3- (4-) angled, with 2 grooves on each face. And they are light brown in colour. In order to expose the rows of rounded blackish oily seeds, each with 3 papery wings, it splits along each angle.

The tree shape is forked from the base area. Bark is smooth, dark grey slash thin and yellowish. The Twigs and shoots of the tree are short which have dense hair. The Crown is made up of single stem wide, open, and typically umbrella shaped. The tree is deep rooted and wood is soft. Moringa oleifera is bisexual and highly cross-pollinated plant due to heteromorphic(Kantilata Thapa*,mousami Poudel and Prabin Adhikari 2019).

Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods, and seeds. In fact, moringa is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach.

Children deprived of breast milk tend to show symptoms of malnutrition. Lacteous are generally prescribed to lactating mothers to augment milk production. The lacteous, made of phytosterols, acts as a precursor for hormones required for reproductive growth. Moringa is rich in phytosterols like stigmasterol, sitosterol and kampesterol which are precursors for hormones. These compounds increase the oestrogen production, which in turn stimulates the proliferation of the mammary gland ducts to produce milk. It is used to treat malnutrition in children younger than 3 years.

About 6 spoonsful of leaf powder can meet a woman's daily iron and calcium requirements, during pregnancy. This study provides an overview on the cultivation, nutritional values, medicinal properties for commercial use and pharmacological properties of moringa. There are no elaborate reports on treatment of diabetes and cancer using moringa. This study aims to bridge the gap.

Considering the above facts, an attempt has been made to prepare a calcium and iron enriched paneer using moringa leaves with good sensory, therapeutic, and nutritional properties with the following objectives.

1. To develop high calcium and iron paneer using moringa leaves
2. To evaluate the Physico – chemical, nutritional, and textural properties of the resultant product.
3. To determine the sensory acceptability of the prepared product and to work out the economics of the resultant product.
4. To analysis the microbiological content of the formulated pro

2. REVIEW OF LITERATURE

The literature pertaining to the study on **"DEVELOPMENT OF MORINGA OLEIFERA INCORPORATED PANNER AND ITS SENSORY EVALUATION'** is discussed under the following Headings:

1. **Milk**
2. **Types of milk**
3. **By – Products of milk**
4. **Types of panner**
5. **Health benefits of panner**
6. **Benefits of Moringa leaves**
7. **Nutritional importance panner**
8. **Incorporated composition of panner**
9. **Physico – chemical changes during panner**
10. **Chemical composition of panner**
11. **Sensory quality of panner**
12. **Yield and total solids recovery**

2.0 REVIEW OF LITERATURE

Research works related to enrichment of moringa paneer, Physico – chemical, nutritional, and textural properties of developed paneer, sensory evaluation of enriched moringa and paneer are reviewed in this chapter.

2.1 Milk

Cow's milk has long been considered a highly nutritious and valuable human food, and is consumed by millions daily in a variety of different products. Its nutrient composition makes it an ideal medium for bacterial growth, and therefore it can be considered one of the most perishable agricultural products because it can so very easily be contaminated (Bryan 2010, Bramley & McKinnon 2010,

Heeschen 2011). Many contaminating organisms only spoil the product, thereby reducing its shelf-life. Some, such as lactic acid bacteria, are useful in milk processing, causing milk to sour naturally.

Other bacteria, are pathogenic to man and can transmit disease if the milk is consumed untreated (Sharp et al. 2015, Heeschen 2011). Unlike meat and meat products, milk is less likely to be subjected to any subsequent heating by the consumer before consumption and contaminated milk is therefore potentially more dangerous (Steele et al. 2007). The high fat content of milk protects pathogens against gastric acid, while its fluid nature ensures a short retention time in the stomach (Potter et al. 2014, Sharp et al. 2015).

Raw milk of good hygienic quality is necessary to produce milk products of good quality and adequate shelf-life and to provide a safe, sound, and wholesome food for the consumer. Since milk is a liquid, it is in contact with some type of equipment or surface from the time it is removed from the cow until it is consumed. Milk freshly drawn from a disease-free udder contains small numbers of bacteria (500 to 1 000 bacteria per mq) which derive from organisms colonizing the teat canal (Bramley & McKinnon 2010).

Milk quality starts to deteriorate immediately after milking due to bacteria entering the milk from a wide variety of sources. These bacteria may originate from soil, water and faeces that collect on the skin of the cow and unavoidably end up in the milk. Once micro-organisms get into the milk they multiply rapidly.

The speed at which milk quality declines depends on the hygiene of the 1 milker, milking equipment and bulk tank, as well as the temperature and length of time that milk is stored before sale to the consumer or treatment at a factory (Luck 2016). Microbial growth can be controlled by cooling the milk, as most micro-organisms reproduce more slowly in colder environments.

Pathogenic bacteria may also be present in raw milk as a direct consequence of clinical or subclinical mastitis (Giesecke et al. 2014). In 20114 Giesecke et al. reported that subclinical mastitis was prevalent in at least 75.5% of South African dairy herds which were affected at levels ranging from moderate to very serious.

Mastitis affects a variety of compositional parameters of milk which in tum may affect the dairy technological usefulness, the nutritional and hygienic characteristics of milk (Giesecke et ai. 2014). Among the organisms commonly producing mastitis, Streptococcus agalactiae, Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli) are pathogenic for man (Bramley & McKinnon 2010).

2.1.1 Pathogens found in milk

There have been numerous outbreaks of milk-borne disease in humans with pathogens such as S. aureus, E. coli, Campylobacter spp., Salmonella spp., Listeria spp., and Yersinia spp. Being incriminated during the past century, especially since mass production came into effect (Bryan 2010, Vasavada 2008).

Most of these outbreaks have occurred in raw milk, but there have also been outbreaks of disease after consuming pasteurised milk due to a failure in the pasteurisation system or post-pasteurisation contamination (Porter & Reid 2011, Fahey et al. 2015). Raw milk may contain micro-organisms pathogenic to man which originated either from within or outside the udder.

Human carriers may also be the source of infection in milk-borne outbreaks, as reported for Salmonella infections, and for cases of scarlet fever or septic sore throat due to Streptococcus pyogenes (Bryan 2010, Bramley & McKinnon 2010). Fortunately, all these pathogens can be destroyed by pasteurisation, but problems arise if the milk is contaminated after the heat process (Bramley & McKinnon 2010, D'Aoust et al.2010).

The most important and senous human diseases resulting from the consumption of contaminated raw milk are tuberculosis and brucellosis (Bramley & McKinnon 2010). In both diseases the causative organism, Mycobacterium bovis and Brucella abortus respectively, may be excreted in the milk from infected animals.

Often with Brucella infections, there is little change in the composition of the milk or udder tissue, i.e., mastitis is not present. Under normal circumstances, pasteurisation destroys both Mycobacterium bovis and Brucella abortus, so rendering the milk safe for consumption.

In South Africa, Staphylococcus aureus has been found to be the dominant mastitis-associated organism (Swartz et al. 2004, 1M Petzer, Faculty of Veterinary Science, Onderstepoort, pers. Comm. 1998, L Fourie, Ermelo Provincial Veterinary Laboratory, pers. Comm. 1998).

Staphylococcal mastitis of the cow poses a direct threat to public health, because a proportion of bovine strains produce enterotoxins (Asperger 2014). Consumption of food containing S. aureus enterotoxin leads to food poisoning (Bryan 2010).

As the enterotoxin is heat stable, subsequent pasteurisation of the toxin contaminated milk or any heat treatment attempted by the consumer will not make it safe for consumption. Staphylococcal enterotoxin formation can be prevented by cooling the raw milk timeously, maintaining the cold chain and then effectively pasteurising the product (Asperger 2014).

2.2 Types of milk

- **Cow milk**

Fat constitutes approximately 3 to 4 percent of the solid content of cow milk, protein about 3.5 percent and lactose 5 percent, but the gross chemical composition of cow milk varies depending on the breed. For example, the fat content is usually higher in Bos indicus than B. taurus cattle. The fat content of milk from B. indicus cattle can be as much as 5.5 percent.

- **Buffalo milk**

It has a very high fat content, which is on average twice as high as that of cow milk. The fat-to-protein ratio in buffalo milk is about 2:1. Compared with cattle milk, buffalo milk also has a higher casein-to-protein ratio. The high calcium content of casein facilitates cheese making.

- **Camel milk**

A similar composition to cow milk but is slightly saltier. Camel milk can be three times as rich in vitamin C as cow milk and represents a vital source of this vitamin for people living in arid and semi-arid areas, who often cannot obtain vitamin C from fruits and vegetables. Camel milk is also rich in unsaturated fatty acids and B vitamins. Milk from Bactrian camels has a higher percentage of fat than milk from dromedaries, but levels of proteins and lactose are similar. Generally, camel milk is consumed raw or fermented.

- **Sheep milk**

It has higher fat and protein contents than goat and cow milk; only buffalo and yak milk contain more fat. Sheep milk also generally has a higher lactose content than milk from cows, buffaloes, and goats. The high protein and overall solid contents of sheep milk make it particularly appropriate for cheese and yoghurt making. Milk from sheep is important in the Mediterranean region, where most of it is processed into cheeses such as pecorino, CACI Cavallo and feta.

- **Goat milk**

It has a similar composition to cow milk. In Mediterranean countries and in Latin America, goat milk is generally transformed into cheese; in Africa and South Asia, it is usually consumed raw or acidified.

- **Yak milk**

The tastes sweet and has a fragrant, sweetish smell. Yak milk has between 15 and 18 percent solid content, 5.5 to 9 percent fat and 4 to 5.9 percent protein. It therefore has higher solid, fat and protein contents than cow and goat milk, and resembles buffalo milk. Raw milk is used mainly by herders and their families in milky tea. Yak milk can be processed into a variety of milk products including butter, cheese, and fermented milk products.

- **Equine milk**

Horse and donkey milk have very similar compositions. Equine milk, like human milk, is relatively low in proteins (particularly caseins) and ashes and rich in lactose. Compared with that of other dairy species, equine milk contains low levels of fat and protein. Most equine milk is consumed fermented and it is not suitable for cheese making.

- **Liquid milk**

The most consumed, processed and marketed dairy product. Liquid milk includes products such as pasteurized milk, skimmed milk, standardized milk, reconstituted milk, ultra-high-temperature (UHT) milk and fortified milk. Worldwide, less and less liquid milk is consumed in its raw form.

- **Fermented milk**

They are commonly used to make other milk products. They are obtained from the fermentation of milk using suitable microorganisms to reach a desired level of acidity. Fermented products include yoghurt, koumiss, dahi, labneh, ergo, tarag, kurut and kefir.

- **Condensed milk**

Is obtained from the partial removal of water from whole or skimmed milk. Processing includes heat-treating and concentration. Condensed milk can be sweetened or unsweetened, but most is sweetened. In Latin America, for example, condensed milk is often used in cooking and baking instead of jam.

- **Evaporated milks**

The result from the partial removal of water from whole or skimmed milk. Processing includes heat-treating to make the milk bacteriologically safe and stable. Evaporated milks are generally mixed with other foods, such as in milky tea.

2.3 By products of milk

- **Skim milk**

It is obtained during the manufacture of cream. It is rich in solids-not fat content and has high nutritional value. In dairy plants, it is mostly utilized either in standardization for the manufacture of main dairy products or preserved by removing moisture in spray dried form. The skim milk when utilized in either of these two forms or consumed as liquid is not considered a by-product. It is regarded as a by-product only when it is either not economically utilized or utilized for derived by-products like casein and related products, coprecipitates, protein hydrolysates etc.,

- **Butter milk**

It is obtained during the manufacture of butter. Sweet cream buttermilk resembles skim milk in gross chemical composition and is usually admixed with bulk of skim milk for further spray drying or even product manufacture in dairy plants. Desi buttermilk, on the other hand, has long been an important domestic beverage in India. It has high nutritive and therapeutic value. It also finds its way in the preparation of a host of items such as kadhi, dhokla and idle. Also, several federations and private plants sell salted and spiced buttermilk in 200 ml pouches. In the summer, sales average around 45,000 litres a day.

- **Whey**

A dilute, highly perishable greenish yellow fluid and the largest by-product of the dairy world produced during the manufacture of cheese, casein, chhana, paneer, chakka and coprecipitates Its composition and acidity varies widely. It contains about half of the total solids of milk, and is a source of

precious nutrients like lactose, whey proteins, minerals, and vitamins. Whey proteins, though present in small quantity, have high protein efficiency ratio (3.6), biological value (104) and net protein utilisation (95) and are next only to egg protein in terms of nutritive value. Further, being a rich source of lactose, whey is a good fermentation media for several fermented products. In many applications, lactose in whole or deproteinised whey is hydrolysed to glucose and galactose, thereby increasing its sweetness. Such lactose hydrolysed syrups, generally after condensing, are mostly utilised in sweet confectionery products and in ice cream. The market for whey products is estimated at about $ 6.5 billion in sales globally. Future growth is expected to be led by the industry's increasing focus on nutritional products, particularly in the dietary, sports and clinical segments of the market.

- **Ghee**

A ghee industry and is produced in large quantity in India. This nutritious by-product has been studied for its Physico-chemical characteristics and for its utilization in several food products like chocolate burfi, samosa filling, chapatis etc. However, most dairy plants in India have not been utilizing ghee residue profitably except for fat extraction. Most of the ghee residue goes to waste. A sincere R & D work and a strong willingness on the part of manufacturer is required to develop food uses of ghee residue and put it in the market place.

- **Cheeses**

They are produced through the coagulation of milk protein (casein), which is separated from the milk's whey. Hundreds of varieties of cheese are produced, many of them being characteristic to a particular region of the globe. However, most cheese is produced in developed countries. Cheese can be soft, hard, semi-hard, hard ripened or unripened. Cheese's diverse characteristics derive from differences in the compositions and types of milk, processes applied and microorganisms used.

- **Dry milk or milk powder**

Is obtained from the dehydration of milk and is usually in the form of powder or granules.

- **Cream**

The part of milk that is comparatively rich in milk fat; it is extracted by skimming or centrifuging the milk. Cream products include recombined cream, reconstituted cream, prepared creams, pre-packaged

liquid cream, whipping cream, cream packed under pressure, whipped cream, fermented cream and acidified cream.

- **Casein**

The principal protein in milk and is used as an ingredient in several products, including cheese, bakery products, paints and glues. It is extracted from skimmed milk by precipitation with rennet or by harmless lactic acid-producing bacteria.

2.4 Types of Paneers

In the last few decades, consistent efforts have been made for the manufacture of different types of paneers like low fat paneer, recombined and reconstituted milk paneer, dietary fibre enriched low fat paneer, soy paneer, filled paneer, vegetable impregnated paneer and UF paneer. A brief description of such types of paneers is given below.

- **Conventional paneer**

Preparation of conventional paneer is an old age practice which is generally adopted by halwa is in the cities and towns. For preparation of this type of paneer, generally buffalo milk having a fat to SNF ratio of 1:1.65 is preferred. Such paneer is quite rich in fat content.

- **Low fat paneer**

Generally, health-conscious people do not like to consume conventional paneer because of its high fat content. Therefore, efforts have been made to develop low fat paneer without significantly compromising the sensory and textural characteristics. Good quality low fat paneer has been developed at National Dairy Research Institute, Karnal from milk having as low as 3.0% fat (Kanawjia and Khurana 2016). Kanawjia and Singh (2010) reported that fortification of low-fat milk with soya solids improved its rheological and sensory quality along with reduction in the cost of production. Chandan (2007) reported that skim milk paneer and low-fat paneer having 13% and 24% fat, respectively on dry matter basis are available in the western countries. Out of these, former had a chewy, rubbery texture and hard body.

- **Recombined and reconstituted milk paneer**

During summer season there is a drastic curtailment in the supply of milk due to reduction in milk production, whereas demand is more during these days. As a result, the price of paneer goes up. To overcome the seasonal variation, efforts have been made to develop paneer from milk powder and a fat source. Appropriate technology has been developed for the manufacture of acceptable quality paneer from whole milk powder and from skim milk powder and butter oil (Kanawjia and Khurana 2016).

- **Dietary fibre enriched low fat paneer**

With increase in the awareness about the health risks associated with consumption of dietary fat and cholesterol intake, there is an increase in the demand of fibre enriched low fat or non-fat food products. Since paneer prepared from low fat milk result in hard body, coarse, rubbery and chewy texture, bland flavour, poor mouth feel as well as mottled colour and appearance (Chawla et al. 2005), low fat paneer with an improved quality in terms of sensory, rheological and nutritional attributes has been developed by using soy fibre and inulin (Kanawjia and Khurana 2016). These fibres besides improving the texture and sensory properties of low-fat paneer, improves the bowel movement and reduces the chances for colorectal cancer.

- **Soy paneer**

Day by day increase in the cost of milk products has put pressure on researchers for the development of products with high nutritive value but low cost. Soy protein is an outcome of this strategy. This product can be utilized for preparation of various culinary dishes. Babaje et al. (2002) studied the effect of blending soy milk with buffalo milk on the quality of paneer. They observed that coagulation of soy milk results into a white, soft gelatinous mass. The product had bland taste, unique body, and texture. Soy paneer is a cheaper source of good quality paneer. They also noticed that addition of soy milk up to 20% to buffalo milk had no adverse effect on the quality of paneer and resembles almost that of milk paneer in colour, taste, and springiness. Acceptability of soy paneer can be further enhanced by addition of sodium caseinate.

- **Filled paneer**

During flush season, the rate of the milk goes down and farmers feel difficulty in selling milk at normal price. Under such circumstances, milk fat is generally recovered as cream which is subsequently utilized either to produce butter or ghee but skim milk does not get right price. To overcome this problem, skim milk can be utilized for preparation of filled paneer. For this skim milk is blended with vegetable oils/vanaspati or coconut milk. Blending of 10% coconut milk with skim milk resulted in the manufacture of filled paneer with highly acceptable sensory attributes (Venkateshwarlu et al. 2003).

- **Vegetable impregnated paneer**

Impregnation of vegetables not only reduces the cost of paneer but also provides functional properties to it. Bajwa et al. (2005) manufactured vegetable impregnated paneer by incorporating coriander and mint leaves from 5 to 30% in buffalo milk having 5% fat. They reported that yield, ash, crude fibre, ascorbic acid, iron and calcium content of the paneer increased with increase in the level of impregnation whereas fat content decreased. A decrease in the level of sensory scores was noticed with increase in the level of vegetables impregnation although all the samples were very well acceptable.

- **UF paneer**

Membrane technologies can be greatly exploited for the manufacture of paneer. It not only improves the quality and shelf life of paneer but also reduces energy losses. Ultrafiltration process permits retention of greater amount of whey solids in paneer and consequently gives higher yields. The process involves standardization of pasteurized milk to a fat content of 1.5% and SNF to 9.0%, followed by ultrafiltration to a total solids content of 30%. To this glucono-δ-lactone is added @ 0.9% prior to filling in retortable metalized polyester pouches. These pouches were then autoclaved for 15 min during which concomitant thermal texturization also took place resulting in formation of long shelf-life product (Aneja et al. 2002). UF paneer was reported to a shelf life of 3 months at 35 °C and overall acceptability of 8.5 on a 9-point hedonic scale.

2.5 Health Benefits of Paneer

- **Reduces the risk of cancer**

Cancer has become a common disease these days. Among the various types of cancer, on average, one million women suffer from breast cancer. Women in pre-menopause stages are at a greater risk of suffering from cancer. Paneer contains a very high amount of Vitamin D and Calcium and these two components are key players that help in preventing breast cancer. The sphingolipids in paneer and the high amounts of protein help in combating colon and prostate cancer at the initial stages

- Paneer contains Vitamin D and Calcium
- Sphingolipids and Protein combats cancer

Building better bones and teeth

As mentioned above, the richness of calcium and vitamin D makes it an ideal source for bone strengthening. Be it, little kids, or adults, anyone can consume paneer for healthy bones and teeth. Not just this, Calcium plays a key role in the nervous and muscular system as well.

- Vitamin D in paneer strengthens bones
- Calcium promotes normal functioning of the nervous system

An essential component in weight loss programs

Unlike other sources of fat, Paneer contains short chains of fatty acids that are easily digestible. This means, the fat instead of getting deposited, is digested and broken down to release energy. Stored fat is the main reason for obesity. Thus, Paneer is a highly

recommended fatty acid source for people who are fitness freaks or those who undergo weight loss programs.

- Paneer is a rich source of fatty acid
- Easily digestible fats and low carbs help in weight loss

Aids in the normal functioning of the digestive system

The digestive system is an important organ system in the human body. It breaks down the food we consume to provide energy. A defect in the digestive system hinders the normal functioning of the other systems. Paneer contains a very high amount of minerals like phosphorus and magnesium, both of which are essential for the smooth functioning of the digestive system. Magnesium acts as a laxative, whereas phosphorus aids in digestion as well as excretion processes.

- Magnesium acts as a laxative in the digestive system

- Phosphorous helps in normal bowel functioning

Ideal food for diabetic patients

Most patients who suffer from diabetes keep themselves away from dairy products, but paneer is an exception. Paneer is rich in magnesium that regulates the blood sugar level. It also contains a very low amount of carbs and hence diabetic patients can consume this without any fear. Paneer also has the potential to control the drastic fluctuations in blood glucose levels.

- Magnesium in paneer controls blood sugar level
- Low carbs in paneer make it the best food for diabetic patients

Building a strong immune system

Paneer can help build a strong immune system, especially for growing kids. Most respiratory ailments like asthma and bronchitis can be controlled by regular consumption of paneer. It stimulates haemoglobin production and also aids in building a strong immune system. Not just this, the Vitamin B complex present in paneer is highly essential for growing children. It helps in improving concentration and enhances memory in kids.

- Promotes haemoglobin synthesis
- Prevents and cures respiratory ailments

Paneer prevents and protects you from diseases

Paneer contains a very high amount of potassium that helps in maintaining blood pressure levels. This also helps in preventing stroke. Potassium also plays a significant role in preventing muscle cramps, especially in athletes by maintaining fluid levels. Women in the menopause stage also suffer frequent cramps. Daily intake of paneer helps in reducing cramps. Paneer also aids in the prevention of osteoporosis with its very high levels of calcium. It contains a high amount of zinc that is necessary for a normal sperm count in males.

- A boon for women suffering cramps during menopause
- Zinc helps in maintaining normal sperm count

2.6 Benefits of Moringa leaves

Good For Heart

Moringa leaves have the potential to lower cholesterol levels, thereby lowering the risk of heart disease. “Moringa is a great source of zinc and can regulate blood sugar levels, which can help manage or even prevent diabetes.

- **Powerhouse of Antioxidants**

Moringa oleifera is high in antioxidants such as quercetin and chlorogenic acid. Moringa leaf powder can boost antioxidant levels in the blood.

- **Promotes Healthy Skin**

Moringa leaves are high in antioxidant, anti-inflammatory, and antiseptic properties, making them ideal for skincare.

- **Improves Sleep**

Increasing the overall nutritional value of the food you consume each day is a great goal, as is getting more sleep. Sleep and nutrition both have an impact on each other. Powerful foods, like Moringa leaves are essential because they boost energy, flush the body with vitamins, and reduce inflammation.

- **Good For Digestion**

Consuming moringa leaves may help with digestive issues. People with ulcerative colitis, gastritis, bloating, and constipation may include moringa leaves in their diet.

2.7 Nutritional Importance of Paneer

Paneer is of great value in diet, especially in the Indian vegetarian context, because it contains a high level of fat and proteins as well as some minerals, especially calcium and phosphorus. It is also a good source of fat-soluble vitamins A and D. So, its food and nutritive value is 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).

The protein efficiency ratio (PER) and biological value (BV) of *paneer* prepared from buffalo milk and cow milk is 3.4, 2.3; 86.56 and 81.88, respectively. The digestibility coefficient values for both types of *paneers* were nearly identical. Buffalo milk *paneer* had higher net protein utilization (83.10) as compared to cow milk *paneer* (78.28) (Srivastava and Goyal 2007).

2.8 Incorporated composition of Paneer

- **Moringa Tea**

In her book "How to Lose Back Fat," Cynthia Trainer claims that "Weight loss has been linked to moringa tea. The leaves are low-fat and nutrient-dense, making them an excellent replacement for high-calorie foods. Energy is produced rather than stored as fat." To make moringa tea, simply boil leaves in water, strain, and drink.

- **Murunga Podi**

Podi is a dry South Indian masala that is often served with dosa, idle and more. It is typically made with various dals, garlic, and spices; this dry masala adds a unique flavour to your basic meals. Today, we have a similar recipe, but with ten times the benefit. Murunga Keera Podi, which translates to drumsticks leaf podi, is a drumstick leaves podi.

- **Smoothies**

Given moringa's nutritional value, whether in powder or whole-leaf form, including it is worthwhile. It pairs particularly well with green smoothies.

- **Soups**

Moringa leaves can be added to any liquid recipe, especially soups like chicken soup, clear soup, and many others.

2.9 Physico – chemical changes during Paneer

The coagulation process is a consequence of the chemical and physical changes in casein brought about by the combined influence of heat and acid. This phenomenon involves the formation of large structural aggregates of casein from the normal colloidal dispersion of discrete casein micelles, in which milk fat and coagulated serum proteins get entrapped along with some whey.

During this stage, the major changes that take place include:

(i) progressive removal of tricalcium phosphate from the surface of casein and its conversion into monocalcium phosphate and soluble calcium salt and

(ii) progressive removal of calcium from calcium hydrogen caseinate to form soluble calcium salt and free casein.

2.10 Chemical Composition of Paneer

The chemical composition of *paneer* reported by earlier workers showed a significant variation. These differences may be attributed to the differences in the initial composition of milk, method of manufacture and losses of milk solids in whey.

2.11 Sensory Quality of Paneer

The flavour score of *paneers* decreased with decrease in the fat content of original milk utilized for the same. The panellists could not differentiate flavour profile of *paneer* made from 5.0 to 6.0% fat milk (Bhattacharya et al. 2011). *Paneer* made from milk standardized to even 3.5 and 5.0% fat has been reported to yield good body and texture. Skim milk yields a very hard bodied *paneer*. Sensory score of *paneers* decreased with an increase in the strength of citric acid solution for a specific heat treatment meted to milk (Rao et al. 2014). Sachdeva et al. (1991) observed that the addition of 0.08% calcium chloride to cow milk encouraged the development of *paneer* with compact, sliceable, firm, cohesive body and a closely knit texture. Use of sodium alginate or pregelatinized starch did not help in improving the quality of the filled *paneer* (Roy and Singh 2004).

2.11.1 Hedonic scale

This rating scale method measures the level of the linking of foods, or any other product where an effective tone is necessary. The test relies on people's ability to communicate their feeling of like or dislike. Hedonic testing is popular because it may be used with untrained people as well as with experienced panel members. A minimum amount of verbal ability is necessary for reliable results (O'Mahony, 2006).

The ratings obtained on a hedonic scale may be affected by many factors other than the quality of the test samples. Characteristics of the subjects, the test situation, attitudes, or expectation of the subjects can all have a profound effect on results. A researcher needs to be cautious about making inferences on the bases of comparison of average ratings obtained in different experiments (Stone and Sidel, 2004).

2.12 Yield and Total solids Recovery

Yield of *paneer* mainly depends on the fat and SNF content of milk as well as on the moisture, fat and protein retained in the *paneer*. Under optimum conditions yield ranges from 18 to 20%. Total solids recovery in *paneer* prepared from buffalo milk standardized to 0.1, 3.5, 5.0 and 6.0% fat was 47.08, 57.20, 59.08 and 60.81%, respectively (Bhattacharya et al. 1971). Sachdeva and Singh (1988b) reported that the heat treatment of milk up to 90 °C not only increased the recovery of total solids but also increased the yield of *paneer*. Vishweshwaraiah and Anandakrishnan (2006) prepared *paneer* from cow milk standardized to 3.0, 3.5, 4.0 and 4.5% fat by coagulating at 80 °C, using 2% citric acid solution as coagulant. They recorded 61.96, 64.39, 62.89 and 62.98% total solids recovery in *paneer* and fat loss in whey was 0.12, 0.20, 0.25 and 0.30%, respectively.

3. MATERIALS AND METHODS

The literature pertaining to the study on "**DEVELOPMENT OF MORINGA OLEIFERA INCORPORATED PANNER AND ITS SENSORY EVALUATION"** is discussed under the following headings:

1.Materials

2.Methods

3.Sensory evaluation of moringa oleifera incorporated to panner

4.Chemical analysis of paneer

5.Microbiological Profile

6.Yield calculation of moringa oleifera incorporated to panner

7.Cost calculation of moringa oleifera incorporated to panner

8.Calculation of nutritive value of moringa oleifera incorporated to panner

9.Packaging and storage of panner

3. MATERIALS AND METHODS

The studies were carried out in the department of livestock products technology (Dairy science), Veterinary college and research institute, Tamil Nādu veterinary and animal science university, Namakkal – 637002.

3.1 Materials

3.1.1 Milk

Fresh cow milk obtained from the integrated livestock farm complex, veterinary college, and research institute Namakkal was used.

3.1.2 Muslin cloth

Fresh and clean muslin cloth will be purchased from local market for the drainage of whey.

3.1.3 Cream separator

Cream separator will be used for standardization of different milk.

3.1.4 Thermometer

Mercury filled glass thermometer with temperature range from 0 to 150ºC will be used for the determination of temperature of milk.

3.1.5 Stirrer

Long handled stirrer with flattened end made up of mild steel will be used for stirring the milk during addition of coagulant.

3.1.6 Paneer blocks

Steel block of size 7 × 6 × 4 inches will be used for paneer preparation.

3.1.7 Muffle furnace

Temperature make muffle furnace will be used to determine the ash content in paneer.

3.1.8 Hot air oven

Laboratory hot air oven of 45×45×45 cm size will be used to determine the moisture content in paneer.

3.1.9 Centrifugal machine

Centrifugal machine will be used for the determination of fat content in paneer.

3.1.10 Cheese butyrometer

Cheese butyrometer will be used for the determination of fat content in paneer.

3.1.11 Digestion unit

Digestion unit will be used for the digestion of paneer for determination of protein content in paneer.

3.1.12 Distillation unit

Distillation unit will be used for distillation of distillate for determination of protein content in paneer.

3.1.13 Burette

Burette will be used for the titration of mixed solution for the determination of protein content in paneer.

3.1.14 Chemicals

Analytical reagent (AR) grade reagents will be used for chemical analysis

3.1.15 Moringa Fresh leaves, dry leaves, dry leaf powder

Commercially available in good quality of moringa powder was purchased from village.

3.2 Methods

3.2.1 Standardization of milk

Standardization of milk Fresh cow milk will be subjected to cream separator and skim milk and cream will be obtained. For every treatment milk will be standardized to 5 % fat by Pearson's square method.

3.2.2 Experimental designs

Different treatment of paneer was designed as detailed below. In the three variations of Moringa oleifera was Fresh leaves, Dry leaves, and Dry leaf powder. In that Dry leaf incorporated Panner was Good.

Table 1: Experimental design of trial

PY	-	Control, without addition of moringa oleifera dry leaf
PMTRS 1	-	Moringa Oleifera Fresh leaf 0.5% with milk
PMTRS 2	-	Moringa Oleifera dry leaf 0.5% with milk
PMTRS 3	-	Moringa Oleifera dry leaf powder 0.5% with milk

PMTHS 1	-	Moringa oleifera Dry leaf 0.5% with milk
PMTHS 2	-	Moringa oleifera Dry leaf 1% with milk
PMTHS 3	-	Moringa oleifera dry leaf 1.5% with milk

Table 2: Experimental design of treatment

3.2.3 Formulation of moringa oleifera Fresh leaves

Raw leaves of moringa oleifera were collected in village.

3.2.4 Formulation of moringa Oleifera dry leaf & dry leaf powder

Fresh leaves of moringa oleifera were collected in village. After collection the leaves were shadow dried in the at room temperature for 48 hours and crushed the dry leaf powder. In the three variations

3.2.5 Formulation of moringa oleifera for incorporation into paneer

Moringa oleifera dry leaf was incorporated in milk at 0.5%,1%1.5%, level for paneer preparation. Different levels of moringa oleifera (0.5%,1%,1.5%) was added in the paneer treatment samples to assess the optimum level of inclusion based on the sensory.

3.2.3 Procedure for the Formulation of plain paneer

The Plain paneer was prepared using fresh milk. The milk is heated to 90ºC without Holding. There after the temperature of milk brought down to cooling to 75ºC coagulated at this temperature using 1% citric acid solution. The temperature of citric acid solution also maintained at 70ºC citric acid solution

is added with continuous stirring till clear whey separates out. After complete coagulation the stirring is stopped and the coagulated mass is allowed to settle down for about 5minutes. The whey is drained through stainless strainer. There after the press coagulated after filled in muslin cloth and removed the blocks and cut into pieces and immersed in the chill water of 4ºC for about 2hours. The paneer is cut into desirable size and packaged suitable placing material finally it is stored under refrigeration till marketing and its consumption.

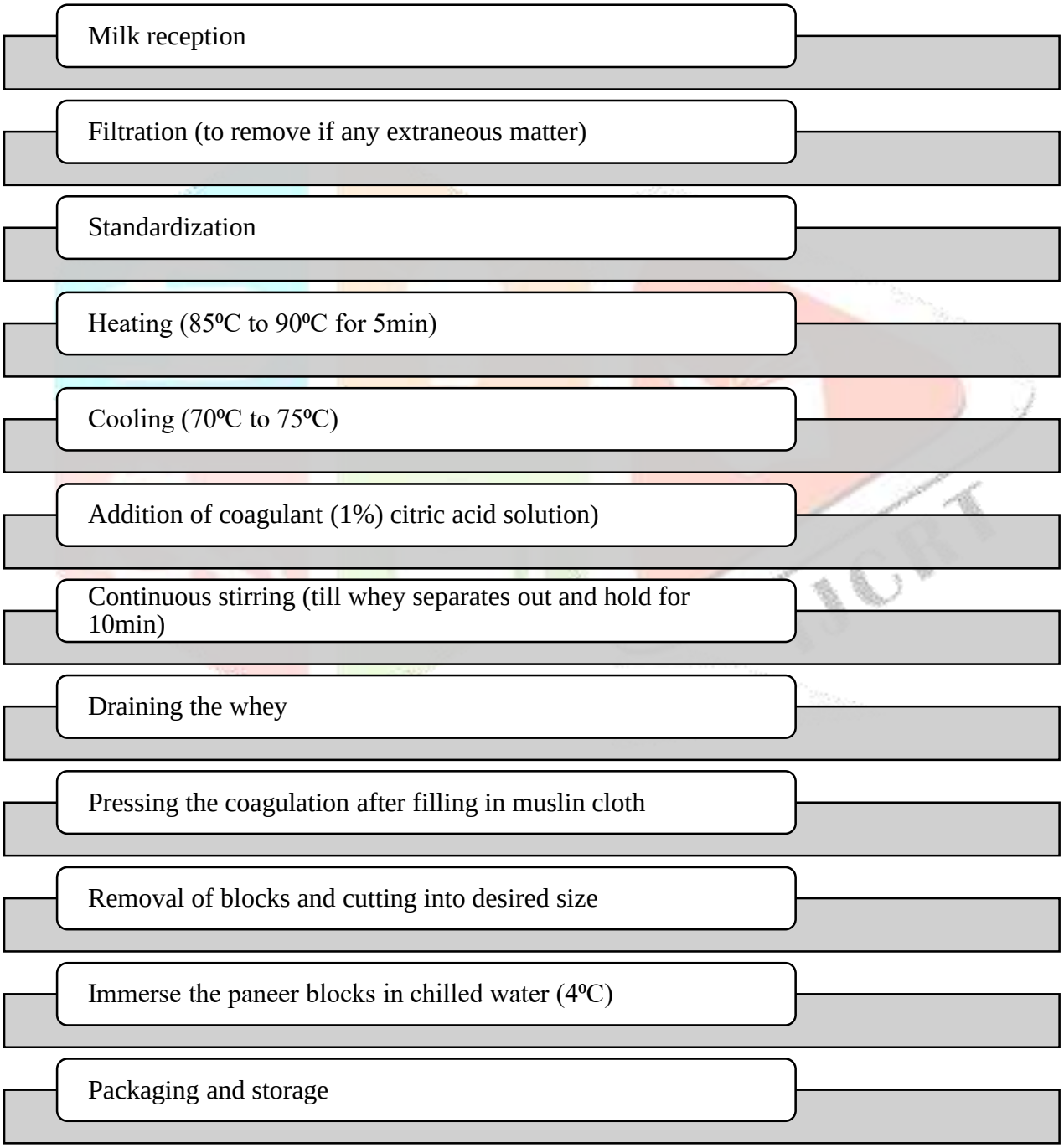


Figure 1

Flow diagram of formulation of plain paneer

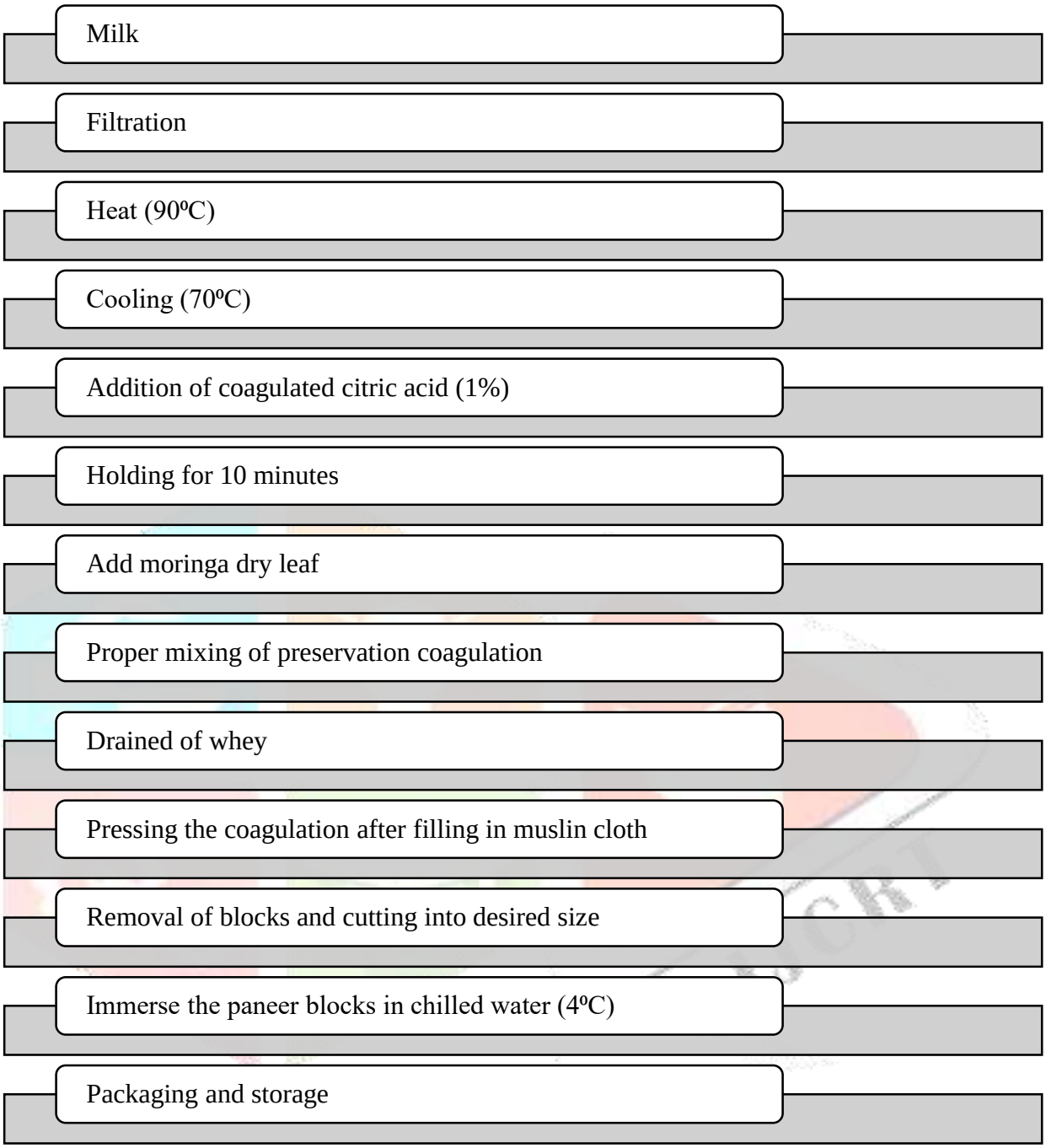


Figure 2

Flow diagram of formulation of moringa oleifera incorporated paneer

PLATE -1

MILK

PLATE – 2

MORINGA OLEIFERA FRESH LEAVE

PLATE -3

MORINGA OLEIFERA DRY LEAVES

PLATE 3

MORINGA OLEIFERA DRY LEAF POWDER

(Crushing)

PLATE – 5

CONTROL SAMPLE OF PANNER

PLATE – 6

FRESH LEAF OF PANNER (TRIAL 1)

PLATE - 7

DRY LAEF OF PANNER (TRIAL 2)

PLATE – 8

DRY LAEF POWDER (TRIAL 3)

PLATE – 9

TREATMENT 2

PLATE – 10

TREATMEMT – 3

3.3 Sensory evaluation of moringa oleifera incorporated to panner

Sensory evaluation can be defined as a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses (sight, smell, taste, touch and hearing) for the purpose of evaluating consumer products.

The incorporation of moringa oleifera to panner' has been evaluated for its acceptability by 10-point hedonic scale with a panel 10 members by administering a score card consisting of ten sensory characteristics like, colour and appearance, taste, flavour, texture and overall acceptability. The scores obtained from the sensory evaluation were used to calculated mean and standard deviation and the most acceptable product was determined.

3.3 Chemical analysis of Paneer

3.3.1 Determination of pH

The pH of paneer was measured as described by Awad et al. (2005). Approximately 20 g paneer was mixed with 20 ml warm distilled water (35-40°C) and slurry was prepared. pH of paneer was measured directly by inserting the electrode into the slurry.

3.3.2 Determination of moisture content

Moisture Content 10 gm of sample was transferred in pre-weight flat bottom aluminium moisture cup, which was transferred to hot air oven at 110±2ºC and kept for 16±1 hrs.

Moisture content was calculated by applying the following formula: (AOAC, 1995).

were,

Moisture Content % = W2 − W3\W3 − W1 × 100

W1 = Weight of empty cup,

W2 = weight of cup + sample,

W3 = Weight of cup + dried sample

3.3.3 Determination of Fat

The fat content of paneer will be determined as per the method cited in Bureau of Indian standards (1981)

3.3.4 Determination of total solids

Total solids of milk will be determined by standard gravimetric method cited in Bureau of Indian standards (1981).

3.4 Microbiological Profile

3.4.1 Standard plate count

It will be determined by the method cited in ISI (IS: 5402) 1969 by using tryptone dextrose agar medium.

3.4.2 Yeast and Mould count

Yeast and mould counts will be determined by the method cited in ISI. (IS: 5403) 1969 using potato glucose agar

3.6 Yield calculation of moringa oleifera incorporated to panner

The yield of the developed products was calculated using the following formula

$$\textbf{Yield\%} = \frac{\text{Weight of the formulated product}}{\text{Weight of the raw ingredients used for incorporation of the product.}} \times 100$$

3.7 Cost calculation of moringa oleifera incorporated to panner

Cost calculation is made to find the price of the product for selling this may help to know the loss and profit. cost of the prepared moringa oleifera incorporated to panner has been calculated using a standard price list from local market where the ingredients were procured operating cost, packaging material and profit.

3.9 Packaging and storage of panner

Paneer were prepared and packed in LDPE bags and stored at 4±1ºC

4.RESULT AND DISCUSSION

The literature pertaining to the study on **"DEVELOPMENT OF MORINGA OLEIFERA INCORPORATED PANNER AND ITS SENSORY EVALUATION"** is discussed under the following Headings.

4.1 Sensory Evaluation

4.2 Chemical Analysis

4.3 Microbial Analysis

4.4 Yield calculation

4.5 Cost calculation

4.0 RESULTS AND DISCUSSION

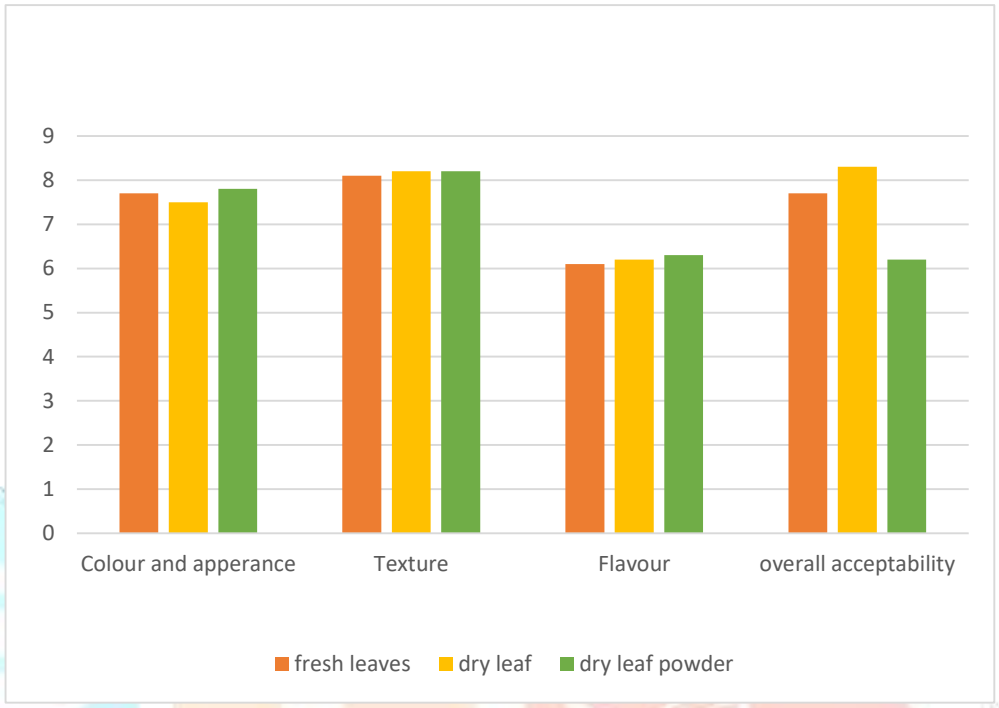
4.1 Standardization various method of moringa oleifera incorporated panner

Sensory evaluation of paneer is to be observed the following characteristics like colour and appearance, flavour, and texture. The sensory was evaluated by the panel member of Diary science. The panner was stored at refrigerator (4 ± 10^0C).

Table 1: Standardization of various method moringa oleifera incorporated of panner

Sl.no	Trial	Sensory attributes			
		Colour and appearance	Texture	Flavour	Overall acceptability
1	Fresh leaves	7.7	7.5	7.8	7.7
2	**Dry leaves**	**8.1**	**8.2**	**8.2**	**8.3**

3	Dry leaf powder	6.1	6.2	6.3	6.2
4	SE±	0.0510	0.0603	0.0707	0.0456



*Each value represents the average of ten determinations

From the graphical representation they have a Fresh leaves, Dry leaf, and dry leaf powder. The Colour and appearance of fresh leaves contains 7.7, Dry leaf contain 8.1 and Dry leaf powder contain 6.1. The texture of incorporated panner Dry leaf has higher than Fresh leaf and Dry leaf powder. The fresh leaf, dry leaf and dry leaf powder has different flavor and dry leaf contains more flavor moringa.

The dry leaf panner get maximum acceptability than the fresh leave and dry leaf powder paneer. The result of present study was in good accordance with results reported by Singh et al., (2014) [15]

Dwivedi et al., (2014) [5], Yadav et al., (2009) [17].

4.1.1 Standardization of various method moringa oleifera incorporated of panner stored at refrigeration temperature (4±1^{0}C).

The data obtained related to changes in sensory parameters of paneer during treatment are to be observed the following characteristics like color, texture and flavor of the paneer presented in

Table 2: Standardization of various method moringa oleifera incorporated of panner and storage refrigeration 4±1^{0}C

Treatment	0-day	14th day	28th day
	Colour and appearance		
Control	7.59	6.10	5.29
Moringa 0.5%	**8.66**	**7.12**	**6.48**
Moringa 1%	8.25	6.94	6.22
Moringa 1.5%	7.87	6.38	5.75
	Flavor		
Control	7.42	6.28	5.40
Moringa 0.5%	**8.50**	**6.66**	**6.14**
Moringa 1%	8.15	6.50	5.97
Moringa 1.5%	7.75	6.35	5.65
	Texture		
Control	7.49	6.18	5.34
Moringa 0.5%	**8.58**	**6.97**	**6.25**
Moringa 1%	8.20	6.91	6.15
Moringa 1.5%	7.82	6.37	5.70
	Overall acceptability		
Control	7.66	6.16	5.35
Moringa 0.5%	**8.73**	**7.19**	**6.55**
Moringa 1%	8.31	6.99	6.29
Moringa 1.5%	7.91	6.45	5.42

All the sensory parameters viz. Colour and flavor, texture appearance, and overall acceptability were found to be significantly ($P<0.05$) lower on successive refrigeration storage in paneer incorporated with Moringa dry leaf including control. The Colour & appearance, flavor, and texture of 0.5% incorporated Moringa dry leaf paneer was found to be significantly higher than 1% and 1.5% Moringa dry leaf incorporated and control paneer (Table-2). There was a gradual and significant ($P<0.05$) decrease in flavor and texture of control, treated paneer. The Overall acceptability of 0.5% incorporated Moringa dry leaf in paneer was significantly higher than 1% and 1.5% Moringa leaf powder incorporated and control paneer.

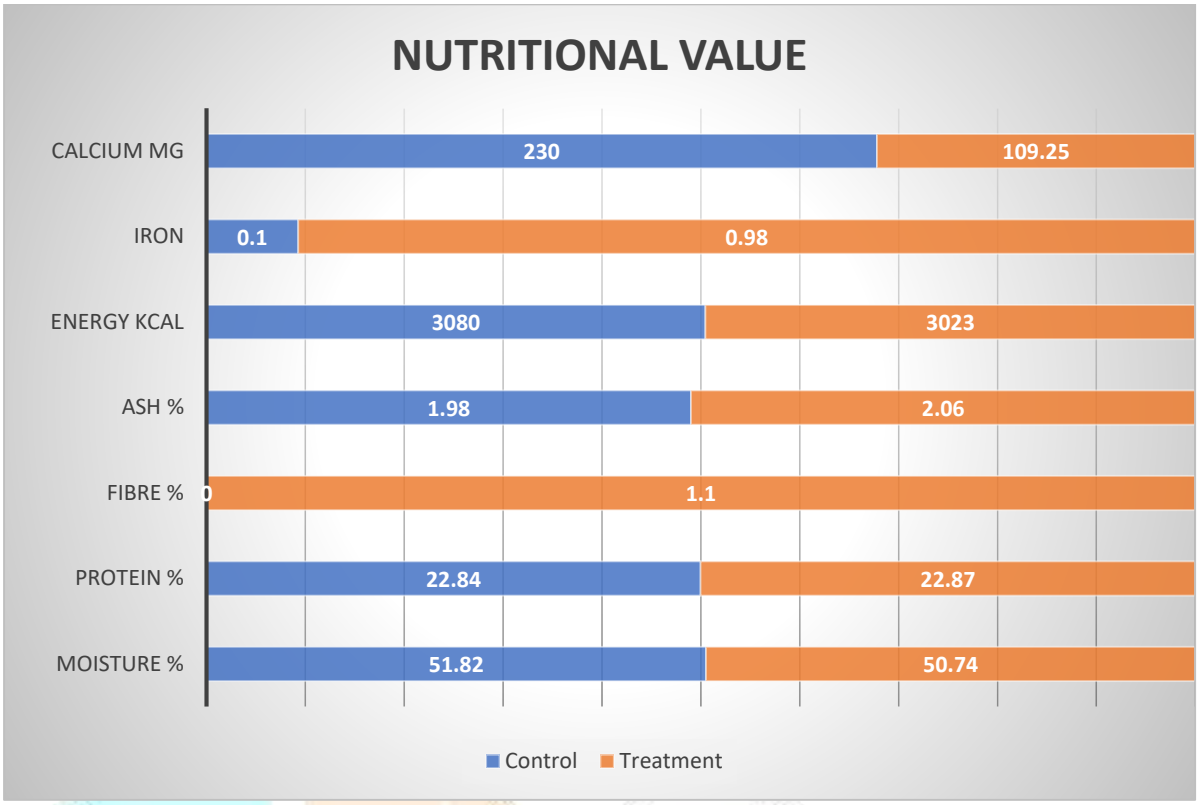
The herbal extract can act as a very good flavoring agent. It can also act as a binding agent. The sensory character can also be enhanced with herbal extract incorporation in milk. It has positive effect by inhibiting discoloration and off odor formation in different milk product during refrigeration storage (Deshmukh et al., 2009 [10] and Ahmed & Bajwa (2019) [1].

4.2 Chemical analysis of panner incorporated moringa oleifera

The composition of treatment was analysed and the results obtained are displayed in the below table.

Table.3 Proximate analysis data of paneer incorporated moringa oleifera

Sl.no	Parameters	Control	Treatment
1	Moisture (%)	**51.82**	**50.74**
2	Crude protein (%)	**22.84**	**22.87**
3	Crude fibre (%)	**0**	**1.1**
4	Ether extract (%)	**23.36**	**23.22**
5	Total ash (%)	**1.98**	**2.06**
6	Energy (kcal)	**3080**	**3023**
7	Iron (mg)	**0.1**	**0.98**
8	Calcium (mg)	**230**	**109.25**



From above graphical representation. Similarly, moisture content of control and treatment are 51.82%, 50.74%, respectively. On a comparative account, protein content of control and treatment is 22.84% and 22.87% control contain low protein. Even though the treatment has higher crude fibre range than control paneer. As the ether extract value signifies that control has the higher ether content, though treatment. Therefore, comparatively gross energy of control higher treatment. As the values of total ash are 1.98% and 2.06% in control and treatment. The iron content of both control and treatment is 0.1mg and 0.98mg. The calcium of control and treatment is 230 and 109.25 The treatment of iron has higher than control because it has incorporated moringa leaves.

4.3 Microbial Analysis of panner incorporated moringa oleifera

4.3.1 Yeast and mould count

Table 5: Yeast and Mould count

Treatment	0-day	14th day	28th day
Control	ND	1.72 ± 0.011^{Ac}	1.72 ± 0.011^{Ac}
Moringa 0.5%	ND	1.55 ± 0.011^{Bc}	1.55 ± 0.011^{Bc}
Moringa 1%	ND	1.40 ± 0.010^{Cc}	1.40 ± 0.010^{Cc}
Moringa 1.5%	ND	1.25 ± 0.008^{Dc}	1.25 ± 0.008^{Dc}

The yeast and molds were not detected till 14th day of storage but it appeared in all product from 28th day onward. The yeast and molds count of Moringa leaf powder incorporated paneer was significantly ($P<0.05$) lower than control on 14th and 28st day of storage (Table-5). It was also indicative of the fact that control paneer was not suitable but Moringa dry leaf incorporated paneer was found to be suitable for human consumption even on 28th day of refrigeration storage. Moreover, this extract possesses natural fungicidal effect against food borne fungi as supported by Amabye and Tedesse (2016) [2], who worked on anti-fungal and antimicrobial properties of Moringa dry leaf.

4.4.2 Standard plate count

Table 6: Standard plate count

Treatment	0-day	14th day	28th day
Control	2.50 ± 0.013^{Ae}	3.68 ± 0.022^{Ac}	5.30 ± 0.032^{Aa}
Moringa 0.5%	2.35 ± 0.013^{Be}	3.35 ± 0.012^{Bc}	4.32 ± 0.017^{Ba}
Moringa 1%	1.80 ± 0.015^{Ce}	2.85 ± 0.011^{Cc}	3.94 ± 0.022^{Ca}
Moringa 1.5%	1.60 ± 0.005^{De}	2.55 ± 0.009^{Dc}	3.30 ± 0.022^{Da}

The mean values of TPC were significantly ($P<0.05$) low in Moringa dry leaf incorporated paneer than control (Fahey, 2005) [11]. The total plate count has increased significantly ($P<0.05$) on successive refrigeration storage days in Moringa dry leaf incorporated paneer including control. The TPC of control paneer was indicative of fact that the product was not suitable for consumption on 28th day of storage. The TPC value of Moringa leaf powder incorporated paneer were found to be in the

range of 5 log_{10} cfu/gm which is indicative of the fact that Moringa leaf powder extract incorporated paneer were suitable for consumption even on 28th day of refrigeration storage. Similarly, incorporation of Moringa dry leaf extracts was reported to reduce the total plate count during the storage of various meat products (Shah et al.,2015) [24]. In addition, Jayawardana et al. (2015) [13] reported that the total plate count of chicken sausages formulated with 0.5%, 0.75%, and 1% moringa leaves was significantly lower than that of the control during the storage period.

4.6 Yield calculation of incorporated panner in moringa oleifera

Table 7: Yield calculation of incorporated panner in moringa oleifera

Sl.no	Variation	Total yield (%)
1	T	150
2	T1	277

Yield of paneer mainly depends on the fat and SNF content of milk as well as on the moisture, fat and protein retained in the paneer. Under optimum conditions yield ranges from 18 to 20%. The cow milk was standardized and moringa dry leaf has various proportion 0.5%,1%and1.5%. in that 0.5% have good yield compare 1% and 1,5% the yield of treatment is 277 is higher than control 150%

4.6 cost calculation of incorporated panner in moringa oleifera

The cost of production for different treatments of incorporate panner in moringa oleifera was slightly higher than that of control, which can be attributed to the cost of milk and moringa. Though, it is costlier a little bit when compared to the control, the resultant Panner is a healthier incorporated panner, as it possesses numerous therapeutic/functional attributes which will cater to demands of the present day highly health-conscious consumers. Hence, Production of incorporated panner in moringa oleifera with 0.5% with up to 1.5% replacement of moringa was found to be more beneficial at the treatment sample per 100gm with numerous therapeutic properties.

Table 8: Cost calculation for formulation of incorporated panner in moringa oleifera

Ingredients	Cost of ingredients in rupees	Control	Treatment 1

Milk	45(1L)	45	45
Moringa oleifera	268(1KG)	-	18.65
Cost of 100 gm of panner	**Total**	**45**	**63.65**

5.SUMMARY AND CONCLUSION

- Panner has gained widespread consumer acceptance for its nutritional and sensory attributes nowadays primarily by everyone.
- It is an excellent source of Calcium, iron , protein and other nutritional properties but as it is typical of all dairy products.
- Therefore, dairy products are logical vehicle for protein fortification because they have high nutritive value, reach target population, and are widely consumed.
- However, protein fortification is difficult in food processing due to potential oxidized off-flavours, colour changes, and metallic flavours, probably as a result of lipid pro – oxidization of milk fat.
- The Moringa dry leaf was used in preparation of value-added paneer. The developed product exhibited significant ($p>0.05$) anti- oxidant, anti-lipolytic and anti-microbial activity.
- The incorporation of Moringa leaf in value added paneer has enhanced its sensory scores as well as shelf life.
- The result revealed the possible application of Moringa dry leaf as a natural source of anti-microbial and anti-oxidant in development of value-added milk product with potential health benefits.
- The panner was various formulation are Moringa fresh leaves, moringa dry leaf and moringa dry leaf powder(crushing) in that Moringa dry leaf formulated was done various proportion like 0.5%,1%and 1.5%
- The mean colour and appearance scores of paneers incorporated with moringa dry leaf for treatments T1, T2, and T3 respectively.

- Obtained average flavour scores for paneer incorporated with moringa dry leaf indicated that it had grade as 'Like very much.' Treatment T1 had highest score for body and texture while treatment T3 had lowest body and texture score.
- T1 had highest score for mouthfeel while lowest mouthfeel score observed at treatment T3. In present study mouth feel score of paneers incorporated with moringa dry leaf was higher than control paneer.
- This revealed that treatment T1 had highest score for overall acceptability than other treatments.
- The score of overall acceptability for moringa dry leaf incorporated paneer were declines after treatment T1.
- Control had highest yeast and mould count as 1.72 x 103 CFU/gm than other treatments. The fresh samples of developed paneer had standard plate count as 2.50 x 103 CFU/gm, 2.35 x 103 CFU/gm, 1.80 x 103 CFU/gm and 1.60 x 103 CFU/gm for treatments T1, T2, T3 and T4, respectively of 0 days they have 14^{th} and 28^{th} day. The 28^{th} day has higher standard plate count compare to 0 day and 14^{th} day.
- The yield of the treatment 1 is 277% when compared to control is 150% because the milk has heat coagulation (70ºC). The optimum condition of yield 18% to 20%. The cow milk has standardized fat (5%).
- The cost of normal panner 100gm in market 45 rupees and Incorporated Moringa oleifera in panner is 63.65 rupees.
- Moringa is highly beneficial major and minor nutrients more over the rich in iron and calcium, Protein etc…, In moringa used three variants are fresh leaves, dry leaf and dry leaf powder (crushing) in three variant dry leaf has contain highly nutrients compared to fresh leaves and Dry leaf powder(crushing).

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ANNEXURE

1.Determination of pH

Aim

To determine the pH value for panner

Materials Requirements

1. pH meter with glass and calomel electrodes or a combined electrode
2. Buffer solutions of pH 7.0 and pH 9.0 or 4.0
3. Beaker 100 ml
4. Glass rod

Procedure

1. Standardize the pH meter with pH 7.0 buffer solutions and check against another buffer of pH 9.0 or 4.0.
2. Once the instrument is calibrated take about 50 ml sample of well mixed milk or slurry of moist or semi moist food in distilled water in a 100 ml beaker and read the pH at 200 C.

Observation

The pH of milk and milk product is directly read in the instrument.

2.Determination of Moisture content

Aim

To determine the moisture content of panner

APPARATUS REQUIRED

1. non-corrodible air-tight container.
2. Electric oven, maintain the temperature between 1050 C to 1100 C.
3. Desiccator.
4. Balance of sufficient sensitivity.

PROCEDURE

1.Clean the container with lid dry it and weigh it (W1).

2.Take a specimen of the sample in the container and weigh with lid (W2).

3.Keep the container in the oven with lid removed. Dry the specimen to constant weight maintaining the temperature between 105ºC to 110ºC for a period varying with the type of soil but usually 16to24hours

4. Record the final constant weight (W3) of the container with dried soil sample. Peat and other organic soils are to be dried at lower temperature (say 600) possibly for a longer period.

S.No.	Sample No.	1	2	3
1	Weight of container with lid W_1 gm			
2	Weight of container with lid +wet soil W_2 gm			
3	Weight of container with lid +dry soil W_3 gm			
4	Water/Moisture content $W = [(W_2-W_3)/(W_3-W_1)]\ 100$			

OBSERVATIONS AND RECORDING

RESULT

The natural moisture content of the soil sample is _____

3.Determination of fat

Aim

To determine the fat content in the panner

Apparatus required

1. Extraction unit 1043, Soxtec System HT6 - service unit 1046, Soxtec System HT6 –
2. Extraction cups
3. Cup holder
4. Tongs for extraction cups thimbles
5. Thimble adapters
6. Thimble stands
7. Thimble support
8. Thimble handler
9. Holder of thimble support

Reagents

Petroleum ether

Procedure

- Turn on the Service Unit and start to heat up the oil bath (adjusted temperature will be 110 ºC).

- Open the cold water tap for the reflux condensers.
- Attach the thimbles to the adapters.
- Weigh the sample into the thimbles (use the thimble support).
- Move the thimbles to the thimble stand (use the thimble handler).
- Put a cotton plug on the top of the sample and place the thimbles into thimble support attached to the holder (use again the thimble handler).
- Insert the thimbles into the Extraction Unit.
- Weigh the extraction cups (with boiling chips).
- Insert the extraction cups, each with 50 ml of extraction solvent, into the Extraction Unit (use the cup holder).
- Move the extraction mode knobs to the "BOILING" position (thimbles will now be immersed in the solvent) and extract your samples 25 minutes. Make sure that the condenser values are open.
- Move the extraction mode knobs to the "RINSING" position (thimbles will now hang above the solvent surface) and continue in extraction 20 minutes.
- Close the condenser valves and remove extraction solvent from the extracts (after 15 minutes, press the "AIR" button on the Service Unit and open the "EVAPORATION" valve on the Extraction Unit for 5 minutes).
- Release the extraction cups from the Extraction Unit.
- Dry the extracts (the extraction cups) in an oven with adjusted temperature between 103 and 105 ºC for 20 minutes.
- Cool the extraction cups in a desiccator (20 minutes) and weigh them.

4.Determination of Total solids

Aim

The aim of the experiments is determination of total, suspended and dissolved solids in water.

APPARATUS REQUIRED

1. Balance

2. Beaker

3. Measuring Cylinder

4. Filter paper/ or Gooch Crucible

5. Funnel

6. Dropper

PROCEDURE:

(a)Measurement of Total Solids (TS)

(1) Take a clear dry glass beaker of 150 ML capacity (which was kept at 103°C in an oven for 1 hour) and put appropriate identification mark on it. Weight the beaker and note the weight.

(2) Pour 100ml. of the thoroughly mixed sample, measured by the measuring cylinder, in the beaker.

(3) Place the beaker in an oven maintained at 103°C for 24hours. After 24 hours, when whole of the water has evaporated, cool the beaker and weight. Find out the weight of solids in the beaker by subtracting the weight of the clean beaker determined in step (1)

(4) Calculate total solids (TS) as follows:

Total Solids in water= Difference of weight of the beakers / Volume of sample X1000

(b) Measurement of Total Dissolved Solids (TDS)

(1) Same as above (step 1 of total solids).

(2) Take a 100 ml. of sample and filter it through a double layered filter paper or a Gooch Crucible and collect the filtrate in a beaker.

(3) Then repeat the same procedure as in steps (3) and (4) of the total solids determination and determine the dissolved solids contents as follows.

CALCULATION

Dissolved solids, TDS (mg/l) = mg of solids in the beaker / (volume of sample) x 1000 Also total solid (TS)= Suspended Solids + Total dissolved Solids (TDS