CHAPTER-1: INTRODUCTION

The manufacture of indigenous milk products is confined mainly to the non industrial sector in south east Asia (Devendra, 1993). An estimated 50 to 55% of milk produced in India is converted into various traditional milk products including numerous dairy desserts which are deep rooted in ancient traditions and have a strong cultural heritage. One such product is called as kheersa . Kheersa is a semisolid-to-fluid dairy product with partially disintegrated cooked rice grains dispersed in viscous liquid comprising soluble starch from rice grains. Conventionally prepared kheersa has a dark creamish colour as a result of prolonged cooking of rice grains in milk, which normally takes approxi-mately one hour (Arora and Patel, 2017). Kheersa is made by concentrating milk with simultaneous cooking of rice grains and addition of sugar during the process (Jha et al., 2011). Shelf-life of kheersa is very poor and even under refrigeration, it does not keep well for more than 2 days. In spite of its religious value, nutritional significance and commercial potential, these products remain confined to domes-tic kitchens. One of the reasons for the lack of its organised manufacture and marketing is poor shelf-life and lack of technology for large-scale manufacture (Jha et al*.,* 2011).

Cow milk and milk products are good source of all types of nutrients. The quality of milk and milk products can be judge by its compositional parameters like fat percent, SNF percent etc. It depends on breed, age of animal and feed composition. Cow milk contains about 86% water, 4.65% fat, 3.4% protein, 4.6% lactose and 0.54% minerals (Smith et al*.*, 2005). Milk is a good source of Ca and Phosphorous and essential fatty acids. Milk protein has 36% α-Casein, 27% β-Casein, 9% κ-casein and 27% peptides (Hartmann and Meisel, 2007). Casin protein found in the form of colloidal state. Casin percentage in cow milk is about 3%. Milk also contains phospholipids like, lecithin, cephalin, sphingomylin and pigments like carotene, riboflavin and xanthophyll etc (Singh and Agrawal, 2004). Milk of cow is used for preparation of different dairy products as Cheese, Khoa (Mava), Yoghurt, Lassi (Butter milk), Kulfi, Khoya, Rabri, Kheer, Srikhand, Basundi, Condensed milk, powdered milk, toned milk, double toned milk etc In many previous study it was found that cow milk contained higher level of fat, protein as compare to exotic animals (Aleandri et al*.,* 1990). Cow milk contains low cholesterol. It is important for physical and mental development. Milk is also important for bone growth, teeth growth, heart activity and all body function. Cow milk is used in the place of mother's milk for infant feeding. Anemia problem of infants can

also reduce by cow milk. Cow milk contains Vitamin A is important for vision. It helps in healing of peptic ulcer. Vitamin A1, B1 and B2 of milk helps to increase immune system of body. Cow milk destroys harmful digestive system microbes and promotes beneficial bacteria. Cow milk is also used as a fungicidal in human and animals (Medeiros et al., 2012)**.** Cow milk contains lactose sugar which is a important source of energy. Milk is important for all age group people viz. infant, adults and old person (Bowlby, 1958).

Though Kheersa is a tasty and delicious dairy desserts item, considerinng it's food value and self life it has some drawback on health effects. For this reasons, I try my best to increase the food value adding psyllium husk and malta peel powder which is health effective. Malta peel powder also increase fiber content by giving the natural color and flavour of the product (Ojha and Thapa, 2017). Psyllium husk is associated with cardiovascular risk reduction through multiple mechanisms and consuming a variety of cereal fiber sources offers health benefits specific to the source (Bernstein et al., 2013). Certain cereal fibers have been studied more extensively than others and provide greater support for their incorporation into a healthful diet. β-glucan from oats or barley, or a combination of whole oats and barley, and soluble fiber from psyllium reduces the risk of coronary heart disease; inulin-type fructans added to foods and beverages may modestly decrease serum triacylglycerols; arabinoxylan and resistant starch may improve glycemic control. Individuals with low cereal fiber intake should increase their intake of whole grains in order to receive the benefits of whole grains in addition to fiber. For those adjusting to the texture and palatability of whole grains, turning to added-fiber products rich in β-glucan and psyllium may allow them to reach their fiber goals without increasing caloric intake (Kaur, 2011).

Dietary fiber intake provides many health benefits. However, average fiber intakes for US children and adults are less than half of the recommended levels. Individuals with high intakes of dietary fiber appear to be at significantly lower risk for developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing fiber intake lowers blood pressure and serum cholesterol levels. Increased intake of soluble fiber improves glycemia and insulin sensitivity in non-diabetic and diabetic individuals (Hanai et al., 1997). Fiber supplementation in obese individuals significantly enhances weight loss. Increased fiber intake benefits a number of gastrointestinal disorders including the following: gastroesophageal reflux disease, duodenal ulcer, diverticulitis, constipation, and

hemorrhoids. Prebiotic fibers appear to enhance immune function. Dietary fiber intake provides similar benefits for children as for adults (Anderson et al., 2009). The recommended dietary fiber intakes for children and adults are 14 g/1000 kcal (Williams et al., 1995). More effective communication and consumer education is required to enhance fiber consumption from foods or supplements (Kaczmarczyk et al., 2012).

Aims and Objectives of the Study

- To develop a dairy product (Special Kheersa) developed with psyllium husk and Malta peel powder.
- To evaluate the sensory evaluation of the developed product.
- To assess the composition and overall acceptability of the developed product.

CHAPTER-2: REVIEW OF LITERATURE

2.1 Description

Milk products are a physiological substances containing bioactive and nutrients components which have beneficial effects on the newborn infant's growth and the digestive system (Shah, 2000). It may also improve the symbiotic micro flora and the development of lymphoid tissues. Several bioactive compounds are present in milk, notably in fermented food products which are of great importance and include certain specific proteins, vitamins, bioactive peptides, organic acids and oligosaccharides.The consumption of dairy products containing probiotic bacteria would decrease cholesterol absorption (Pereira and Gibson, 2002). Benificial effects of dairy foods on the body fat and body mass may be caused by whey proteins, medium-chain fatty acids and the high level of calciumand other minerals have a noteworthy effect on the reduction of blood pressure. There are several components in milk fat with functional properties. Sphingolipids and their active metabolites may exert antimicrobial influences either directly or upon digestion (Ebringer et al., 2008). The consumption of recommended level of milk and dairy products, as part of a healthy diet.

2.2 History of milk and milk products

Milk has been a part of our nutrition since time immemorial. Rich in nutrients, milk in its various forms has a long, long history- Around 10 000 BC, the "agricultural revolution" occurred changing societies from nomadic tribes to those who settled in communities (Barker, 2009). With this came domesticated animals and the ingenuity for people to use by-products such as milk. In ancient Egypt, milk and other dairy products were reserved for royalty, priests and the very wealthy. By the 5th century AD, cows and sheep in Europe were prized for their milk (Crosby, 2004). By the 14th century, cow's milk became more popular than sheep's milk. European dairy cows were brought to North America in the early 1600s. Louis Pasteur, a French microbiologist, conducted the first pasteurization tests in 1862 (Feinstein, 2008). Pasteur is credited with revolutionizing the safety of milk and, in turn, the ability to store and distribute milk well beyond the farm. Commercial pasteurization machines were introduced in 1895 (Russell, 1895)**.** In 1884, the first milk bottle was invented in New York state. In the 1930s, milk cans were replaced with large on-farm storage

tanks, and plastic coated paper milk cartons were invented, which allowed for wider distribution of fresh milk (Smith-Howard, 2017).

Milk is as ancient as humankind itself, as it is the substance created to feed the mammalian infant (Packard, 2012). All species of mammals, from humans to whales, produce milk for this purpose. Many centuries ago, perhaps as early as 6000-8000 BC, ancient peoples learned to domesticate species of animals for the provision of milk to be consumed by them (Kanwal et al., 2004). These included cows (genus Bos), buffaloes, sheep, goats, and camels, all of which are still used in various parts of the world for the production of milk for human consumption.

Fermented products such as cheeses were discovered by accident, but their history has also been documented for many centuries, as has the production of concentrated milks, butter, and even ice cream (Farnworth, 2003).

Technological advances have only come about very recently in the history of milk consumption, and our generations will be the ones credited for having turned milk processing from an art to a science (Tidd and Bessant, 2018). The availability and distribution of milk and milk products today in the modern world is a blend of the centuries old knowledge of traditional milk products with the application of modern science and technology (McMichael et al., 2007).

The role of milk in the traditional diet has varied greatly in different regions of the world (Drewnowski and Popkin, 1997)**.** The tropical countries have not been traditional milk consumers, whereas the more northern regions of the world, Europe (especially Scandinavia) and North America, have traditionally consumed far more milk and milk products in their diet (Raynolds, 2004). In tropical countries where high temperatures and lack of refrigeration has led to the inability to produce and store fresh milk (Prandini et al., 2009), milk has traditionally been preserved through means other than refrigeration, including immediate consumption of warm milk after milking, by boiling milk, or by conversion into more stable products such as fermented milks.

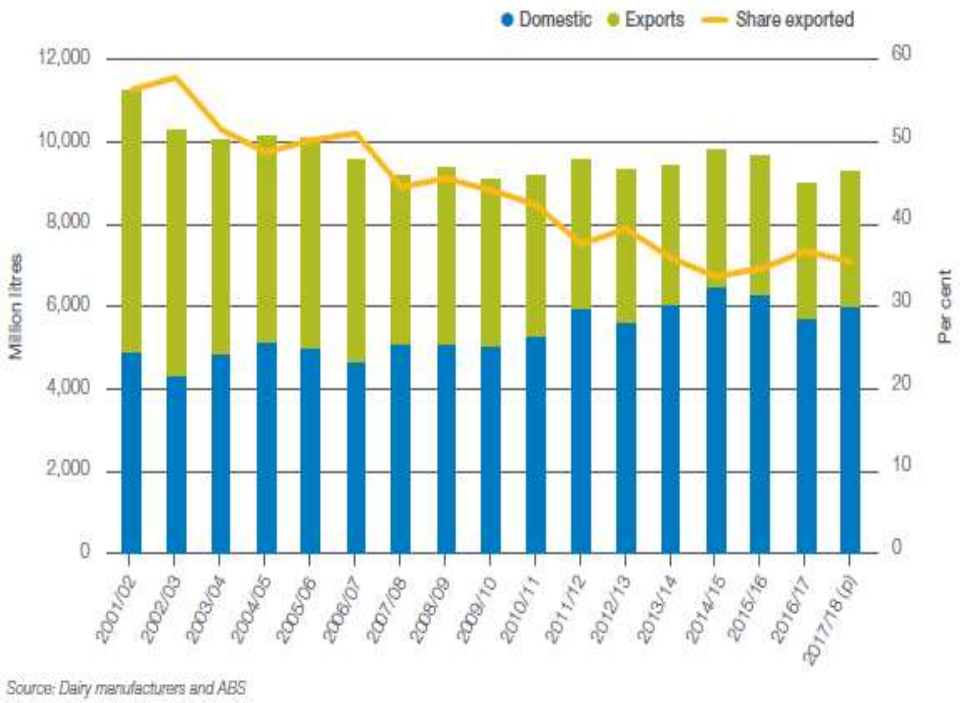

Figure 2.1 Overview of dairy manufacture from 2000 to 2017 (International Market)

2.3 Classification of dairy products

Dairy products have their distinctive characteristics as they were evolved through the ages and continuing to surprise the gourmet even today (Mendelson, 2008). They also aimed at conserving the nutrients of highly perishable milk for a long period.

2.3.1 Concentrated/ partially desiccated products

In this class of products, milk is concentrated using heat energy. Moisture percent in milk gets reduced due to evaporation of vapors of the product (Kamruzzaman et al., 2002). Based on extent of heat treatment product characteristics such as smell, colour, aroma and texture imparted to the products.

i) Khoa
ii) Rabri
iii) Basundi

2.3.2 Heat and acid coagulated products

These are the coagulated products obtained upon addition of acidulant(s) to heated milk. Extent of removal of moisture controls the texture (Ramasubramanian et al., 2013).

i) Paneer
ii) Chhana

2.3.3 Fermented products

Lactic cultures are used to ferment the milk at specific temperature and for specific duration. Dahi is the well known product since from ancient time and misti dahi is popular in eastern region (Sathe and Mandal, 2016).

i) Dahi
ii) Misti dahi
iii) Chakka
iv) Shrikhand
v) Shrikhand wadi

2.3.4 Fat rich products

i) Ghee
ii) Makkhan (desi butter)
iii) Malai

2.3.5 Frozen products

i) Kulfi
ii) Malai – ka – baraf
iii) Milk – ice

2.3.6 Cereal based puddings

i) Kheer
ii) Payasam

2.3.7 Indian milk confections

2.3.7.1 Khoa based sweets

i) Gulabjamun
ii) Burfi
iii) Kalakand
iv) Milk cake etc.

2.3.7.2 Channa based sweets

i) Rasogolla
ii) Rasomalai
iii) Sandesh etc.

2.3.7.3 Chhana and khoa based sweets

i) Kala-Jamun
ii) Pantooa

2.3.7.4 Miscellaneous milk sweets

i) Milk agar cake
ii) Colostrum pudding

2.3.8 Refreshing beverages

i) Lassi
ii) Chhachh
iii) Raabadi

2.3.9 Miscellaneous products

i) Kadhi
ii) Raita
iii) Dahiwada

2.4 Health effects of dairy products with psyllium husk

Psyllium is a soluble fiber derived from the seeds of Plantago ovata, an herb mainly grown in India (Verma and Mogra, 2013).It's used as a dietary supplement and is usually found in the form of husk, granules, capsules or powder. However, it can also be obtained through fortified breakfast cereals and baked goods .Psyllium husk is the main active ingredient in Metamucil, a fiber supplement often used to reduce constipation (Pittler et al., 2005).Because of its excellent water solubility, psyllium can

absorb water and become a thick, viscous compound that resists digestion in the small intestine.Its resistance to digestion allows it to help regulate high cholesterol, triglycerides and blood sugar levels. It can also aid weight management and relieve diarrhea and constipation (Singh, 2007). Psyllium seed husks are used as a regular dietary supplement to improve and maintain regular GI transit to relieve constipation, irritable bowel syndrome, diverticular disease, and diarrhea (Cabré, 2011). Some recent research is also showing them to be promising in lowering cholesterol and controlling diabetes.

2.4.1 Benifits of psyllium husk

Psyllium husk can be found in various forms and has many health benefits. Psyllium relieves constipation. It is used as a bulk-forming laxative. It works by increasing stool size and therefore helps relieve constipation (Singh, 2007). Initially, it works by binding to partially digested food that's passing from the stomach into the small intestine. It then helps with the absorption of water, which increases the size and moisture of stools. The end product is bigger and more easily passable stools. One study found that psyllium had a greater effect than wheat bran on the moisture, total weight and texture of stools. Another study showed that taking 5.1 grams twice a day for two weeks significantly increased the water content and weight of stools, as well as the total number of bowel movements, in 170 individuals with chronic constipation (Eoff and Lembo, 2008). For these reasons, taking psyllium supplements promotes regularity.

Psyllium has also been shown to relieve diarrhea. It does this by acting as a water-absorbing agent, which can increase stool thickness and slow down its passage through the colon. One study showed psyllium husk significantly decreased diarrhea in 30 cancer patients undergoing radiation therapy. Another study treated eight people who had lactulose-induced diarrhea with 3.5 grams, three times daily (Washington et al., 1998). Doing so increased their stomach emptying time from 69 to 87 minutes, which meant fewer bowel movements. So, psyllium can both prevent constipation and reduce diarrhea, effectively helping to normalize our bowel movements if we are having problems (Tack and Müller–Lissner, 2009).

Fiber supplementation has been shown to control glycemic response to a meal and reduce insulin and blood sugar levels (Jenkins et al., 1976). This is particularly the case with water-soluble fibers like psyllium.In fact, psyllium works better than other fibers

like bran. This is because its gel-forming fibers can slow down the digestion of food, which helps regulate blood sugar levels (Mudgil and Barak, 2013). One study treated 56 diabetic men with 5.1 grams of psyllium twice per day for eight weeks (Ziai et al., 2005). In another study in people with type 2 diabetes, a higher daily dose (five grams consumed three times per day) for six weeks resulted in a 29% reduction in blood sugar levels within the first two weeks. Because psyllium is able to slow down the digestion of food, it's recommended to take it with food, rather than on its own, so it has a greater effect on your blood sugar levels .It seems that a daily dose of at least 10.2 grams can promote lower blood sugar levels (MacDonald et al., 2009).

Fibers like psyllium that form viscous compounds can help control appetite and aid weight loss (Papathanasopoulos and Camilleri, 2010) . (Bergmann et al., 1992) had 12 healthy participants consume 10.8 grams of psyllium immediately before a meal. They experienced significantly delayed stomach emptying from the third hour after the meal and prolonged sensations of satiety six hours after the meal. One dose was consumed three hours before a meal, while the other dose was consumed immediately before a meal.The results indicated increased feelings of fullness one hour after the meal and reduced total fat intake during the day, compared to the placebo. However, studies investigating a direct relationship between psyllium and weight loss seem to show mixed results. One study found that 16 weeks of a calorie-restricted diet paired with three grams of psyllium either twice or three times daily resulted in an average weight loss of 9.9 pounds (4.52 kg) and 10.12 pounds (4.60 kg), respectively.

Furthermore, another study showed that psyllium supplementation on its own, as well as paired with a fiber-rich diet, resulted in a significant reduction of weight, body mass index and percentage of body fat (Slavin, 2013). In contrast, other studies did not report significant effects on body weight.

Psyllium is able to bind to fat and bile acids, which promotes their excretion from our body (Turley et al., 1996). In the process of replacing these lost bile acids, the liver uses cholesterol to produce more. As a result, blood cholesterol levels decrease.One study reported an increase in bile acid synthesis and lowered Low density lipoprotein (LDL), ("bad") cholesterol in 20 individuals treated with 15 grams of psyllium daily for 40 days . In another study, 47 healthy participants experienced a 6% reduction in LDL cholesterol after taking 6 grams each day for six weeks. Furthermore, psyllium can help increase High density lipoprotein (HDL),("good") cholesterol levels. For instance, taking 5.1 grams twice a day for eight weeks resulted in a decrease in total and LDL

cholesterol, as well as an increase in HDL levels in 49 patients with type 2 diabetes. Lastly, one study treated 125 type 2 diabetics with 5-gram doses of psyllium three times a day for six weeks. Participants experienced increases in HDL cholesterol up to 45.7% . Interestingly, a review of 21 studies reported that reductions in total and LDL cholesterol are dose dependent. This means greater results were observed with treatments of 20.4 grams of psyllium per day than 3 grams per day.

Adding water-soluble fibers like psyllium to our diet might reduce blood triglycerides, blood pressure and the risk of heart disease (Bell et al., 1990**)**. (Levin et al., 1990) confirmed that 5 grams of psyllium three times daily for six weeks reduced triglycerides by 26%, compared to the placebo.Moreover, in 40 patients with type 2 diabetes, triglyceride levels were significantly reduced after two months of treatment with psyllium fiber. Furthermore, a diet with an additional 12 grams of fiber from psyllium supplementation reduced systolic blood pressure by 5.9 mmHg in 36 people with high blood pressure.Lastly, another study in obese individuals showed that a 7-gram daily dose for 12 weeks led to a seven percent decrease in blood pressure in the first six weeks of treatment

Prebiotics are non-digestible compounds that nourish intestinal bacteria and help them grow (Gibson et al., 2017)**.** Psyllium is considered to have prebiotic effects. Although psyllium is somewhat resistant to fermentation, a small portion of psyllium fibers can be fermented by intestinal bacteria. This fermentation can produce short-chain fatty acids (SCFA), which have been linked to health benefits. (Cummings and Kong, 2004) showed that 10 grams twice a day for 12 months increased the production of the SCFA butyrate. Also, because it ferments more slowly than other fibers, it doesn't increase gas and digestive discomfort. In fact, treatment with psyllium for four months helped reduce digestive symptoms by 69% in patients with ulcerative colitis (UC) . Furthermore, a combination of psyllium and probiotics seems to be particularly effective at treating ulcerative colitis and Crohn's disease.

2.5 Benifits of citrus peel:

Citrus peels are the skins of fruits such as lemons, oranges,malta, limes or grape fruits (Đilas et al., 2009). According to Medicinal Herbs & Spices, citrus peels have previously been known for their high levels of vitamin C and its associated health benefits (Alothman et al., 2009). However, as scientists learn more about citrus peels, it has become clear that they may offer additional health benefits. Regardless, always

discuss our health concerns with our doctor, as these additional health benefits have not been confirmed.

Figure 2.2: Malta peel and Malta peel powder

According to Natural News.com, new research published in the "Journal of Life Sciences" indicates that citrus peel extract containing polymethoxylated flavones (PMFs) may help prevent diabetes (Kurowska and Manthey, 2004). The research showed that citrus peel extract reduced the level of serum triglycerides and cholesterol, both of which are known to contribute to disorders such as diabetes and obesity. Therefore, citrus peel extract may improve insulin sensitivity.

According to Prepared Foods Network, citrus peels may contribute to lower risks of heart disease (Chau et al., 2004). A study published in the "Journal of Agriculture and Food Chemistry" found that the PMF compounds in citrus peels have the potential to lower cholesterol when included in your diet. " A similar study in humans also revealed lower levels of total cholesterol.Citrus peels can be added to foods such as soups, salads, chicken or fish to experience these potential benefits.

Citrus peels contain high levels of antioxidants. As antioxidants, citrus peels may contribute to the protection of our DNA from cancer-causing damage (Kaur and Kapoor, 2001). According to Medicinal Herbs & Spices, citrus peels contain greater amounts of antioxidants than vitamin E. When used in their natural form, the antioxidant effects of citrus peels are enhanced by the high levels of vitamin C found in citrus fruits.

CHAPTER-3: MATERIALS AND METHODS

The research work was conducted in the Department of Food Processing and Engineering, Department of Applied Food Science and Nutrition, Department of Animal Science and Nutrition and Poultry Research and Training Center (PRTC) of Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh, from 1st June 2018 to 30th july 2019 for development and quality evaluation of a dairy product (Special Kheersa) developed with psyllium husk and malta peel powder.

3.1 Experimental design

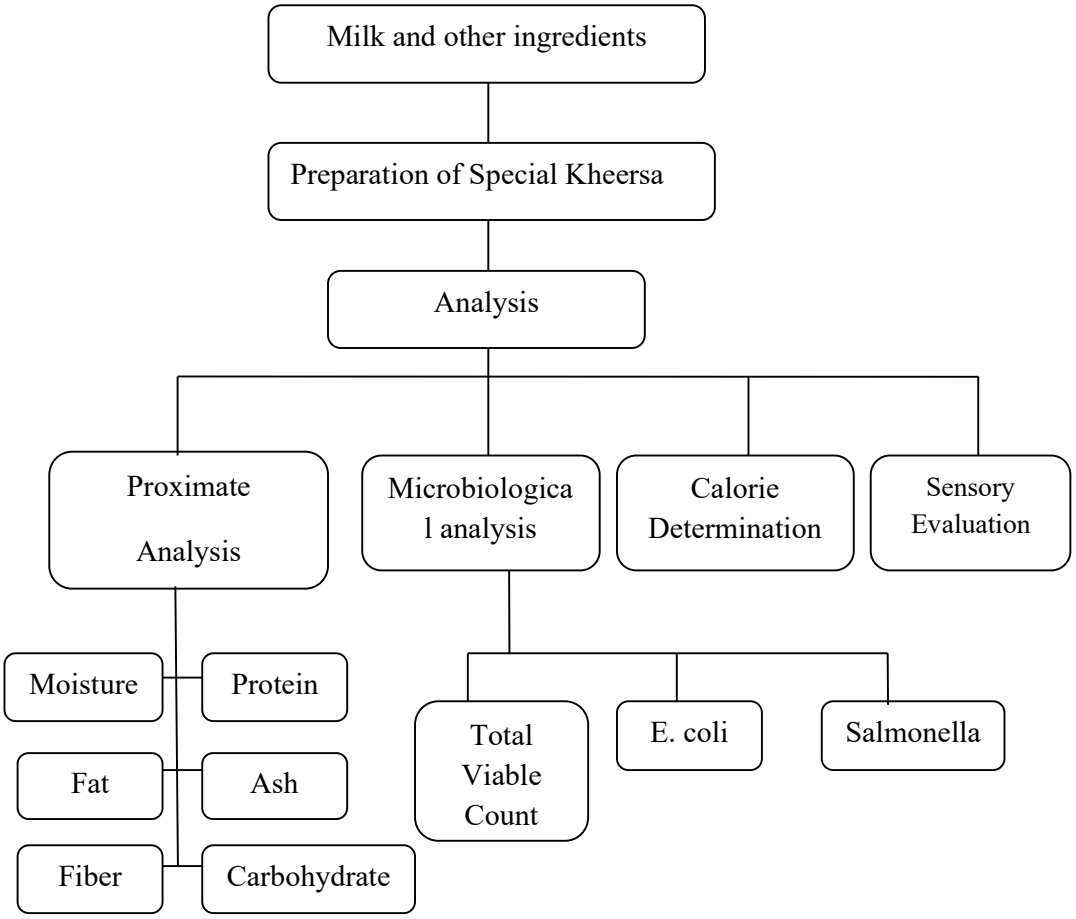

Figure 3.1 Study design

3.2 Raw Materials:

Raw cow milk, Powdered milk, Sugar, Psyllium husk, Bread crumb, Malta peel powder & Pistachio nut are used as a raw materials.

3.3 Collection of Raw Materials

The raw cow milk and other ingredients were purchased from local market and super shop, Chattogram.

Table 3.1 Formulation of Special Kheersa

Ingredients	Sample 1 (T_1)	Sample 2 (T_2)	Sample 3 (T_3)	Sample 4 (T_4)
Raw cow milk	1 L	1 L	1 L	1 L
Powdered milk	75 g	75 g	75 g	75 g
Sugar	110 g	110 g	110 g	110 g
Psyllium husk	-	1.5 g	2.5 g	5 g
Bread crumb	50 g	50 g	50 g	50 g
Malta peel Powder	-	30 g	30 g	30 g
Pistachio nut	20 g	20 g	20 g	20 g

3.4 Methods of preparation

3.4.1 Preparation of malta peel powder:

For the preparation of malta peel powder, at first need to wash the fresh malta by clean water. Then the juice of malta was extracted and collected the peel for the further function. The peel was cut into small pieces and blanching for 5 minutes to inactive the enzymatic function. Then the peel was placed in tray and kept in the cabinet dryer at 60^{o}C for 24 hours. Finally the dried malta peel was grinded by using mixer grinder (MX-AC300). The peel powder was packed in the poly bag and storage in the refrigerator for funther use (Devatkal and Naveena, 2010).

3.4.2 Special Kheersa preparation procedure

At first, the cow milk, powdered milk, sugar and pistachio nut were boiled for 30 minutes to make it concentrate upto 20^0 brix.Then the required amount of bread crumb, psyllium husk was added. Then it was heated to make it concentrated upto 40^0 brix (Jha et al., 2011) . In the last stage malta peel powder was added to the product which give aattractive colour and flavour of the product.After cooling the product was ready for consumption or storage at $<5^0$C.

3.5 Yield & Cost, Selling price:

Product Costing (Cost Card)

Product's Name: Special Kheersa	Recipe cost: 184.41 BDT	Cost per portion: 18.5BDT
Number of portions: 10	Portion size: 100 g	Yield: 1000g

RECIPE Amount (g)	INGREDIENT	RECEIPE COST (BDT)	BDT	EXTENSION Poisha (1/100 BDT)
1000	Raw Milk	70	70	00
75	Powdered Milk	41.25	41	25
110	Sugar	6.16	6	16
5	Psyllium Husk	9	9	00
150	Bread crumb	15	15	00
30	Malta peel powder	3	3	00
20	Pistachio nut	100	40	00
		Total	**184**	**41**

Total final product = 1000 g

No of portion: 10 unit

According to mark up Technique:

Total ingredients cost = 184.41 BDT

No. of portion = 10

Food ingredients cost for per portion = Total ingredients Cost / no. of portion

= 184 BDT / 10

= 18.5 BDT

If profit percentage = 25%

Then the amount of profit = (25/100) × 18.5

= 4.63 BDT / portion

Packaging & other cost = 1.87 BDT / portion

Selling price = Food Ingredients cost + profit + Packaging & other cost

= 18.5 + 4.63 + 1.87

= 25 BDT / pack

3.6 Proximate analysis of Special Kheersa:

Moisture, protein, fat and ash contents of Special Kheersa samples were measured in triplicate according to AOAC methods. The moisture was measured by oven drying at 105^0C to constant weight (AOAC, 2016). The crude protein content was measured by the Kjeldahl procedure (6.25×N). Total lipid was extracted by the AOAC (2016) method using the Soxhlet apparatus. Ash was measured gravimetrically in a muffle furnace (DB33F-Witeg) by heating at 550^0C to constant weight (AOAC, 2016).

3.6.1 Moisture/Water

The moisture was measured by oven drying at 105^0C to constant weight (AOAC, 2016). At first weight of empty crucibles were dried and 5gm of sample was placed on it. Then the crucible was placed in an air oven (thermostatically controlled) and dried at temperature of 105^0C for 24 hrs. After drying, the crucible was removed from the oven and cooled in desiccator. It was then weighed with cover glass. The crucible was again placed in the oven, dried for 30 minutes, took out of the dryer, cooled in desiccator and weighed. Drying, cooling and weighing were repeated until the two consecutive weights were same. From these weights, the percentage of moisture in food samples was calculated as follows:

$$\% \text{ Moisture} = \frac{\text{Loss of weight of sample}}{\text{Initial weight of sample}} \times 100$$

3.6.2 Protein

3.6.2.1 Reagents used: Concentrated H_2SO_4, Digestion mixture (Potassium sulphate 100gm + Copper sulphate 10gm + Selenium dioxide 2.5gm), Boric acid solution, Alkali solution, Mixed indicator solution, Standard HCl (0.1N)

For estimation of protein, the steps were followed:

3.6.2.2 Digestion: 2g sample, 3g digestion mixture and 25 ml H_2SO_4 were taken in a kjeldahl digestion flask. It was heated for 4 hours in a kjeldahl digestion and distillation apparatus. The digestion was completed when the color of the substance was pale yellow.

3.6.2.3 Distillation: After digestion 100ml water, 100 ml 40% NaOH and glass blitz were added to kjeldahl flask which containing about 10 ml 2% boric acid and 2-3 drops mixed indicator. About 100 ml distillate was collected just before the distillation was stopped. The receiving flask was moved so that the tip of the distilling tube was out the distillate. Some distillate was collected in this way to make sure the condenser tube was free from traces of ammonia.

3.6.2.4 Titration: The ammonia collected was titrated with 0.1N HCl solution and titer value was recorded.

The calculation of the percent of protein in the sample using protein factor 6.25.

$$\% \text{ Nitrogen} = \frac{(T_s - T_b) \times \text{Normality of acid} \times \text{meq. } N_2}{\text{Weight of sample (gm)}} \times 100$$

Where,

T_s = Titer value of sample (ml)

T_B = Titer value of Blank (ml)

M eq. of N_2 = 0.014

% Protein = % Nitrogen × 6.25

3.6.3 Fat

Total lipid was extracted by the AOAC (2016) method using the Soxhlet apparatus. The dried sample remaining after moisture determination was transferred to a thimble and plugged the top of the thimble with a wad of fat free cotton. The thimble was dropped into the fat extraction tube attached to a Soxhlet flask. Approximately 75ml or more of anhydrous ether was poured into a flask. The top of the fat extraction tube was attached to the condenser. The sample was extracted for 16hrs or longer on a water bath at 80^0C. At the end of the extraction period, the thimble was removed from the apparatus and distilled off most of the ether by allowing it or collected in Soxhlet tube. The ether was poured off when the tube was nearly full. When the ether reached a small volume, it was poured into a small, dry beaker through a small funnel containing a plug of cotton. The flask was rinsed and filtered thoroughly, using ether. The ether

was evaporated on a steam bath at low heat; it was then dried at 100^0C for 1hr, cooled and weighed. The difference in the weights gave the ether soluble material present in the sample.

The presence of fat was expressed as follows:

$$\text{Fat} = \frac{\text{Loss of ether soluble materials}}{\text{Weight of sample}} \times 100$$

3.6.4 Ash

The ash content of the samples was determined by the standard AOAC method (AOAC, 2003). This method performs oxidization of all organic matter by incineration and determines the weight of remaining ash. Briefly, five grams (5g) of sample was burned and put into muffle furnace with crucible at 550ºC for 8 hrs It was calculated using the following formula:

$$\%\ \text{Ash content} = \frac{\text{Weight of ash}}{\text{Initial weight of sample}} \times 100$$

3.6.5 Crude fiber determination

Crude fiber was determined according to AOAC method (2005). Crude fiber is the water insoluble fraction of carbohydrate consists mainly of cellulose, hemicellulose and lignin. It is estimated through digestion of fat free known amount of food sample by boiling it in a weak solution of acid (1.25% H_2SO_4) for 30 minutes followed by boiling in weak solution of alkali (1.25% NaOH) for 30 minutes at constant volume and then deducting ash from the residue obtained. Following apparatus are used: Liebig condenser, Reflux condenser, Gooch crucible.

3.6.5.1 Reagent required:

1. 0.255N Sulphuric acid solution
2. 10.0% Potassium sulphate solution;
3. Asbestos- Gooch grade.

Calculation**:** The loss in weight represents crude fiber

$$\text{Crude fiber \%} = \frac{\text{Weight of residue with crucible - weight of ash with crucible}}{\text{Weight of sample (moisture and fat free)}} \times 100$$

3.6.6 Determination of total carbohydrates

It was given as the difference between 100 and a sum total of the other proximate components. Hence it was calculated using the formula below:

% CHO = 100% - % (Protein + Fat + Fibre + Ash + Moisture content) (Southgate, 1969).

3.6.7 Determination of energy value of special kheersa

The energy value of the samples were determined by multiplying the protein content by 4, carbohydrate content by 4 and fat content by 9 according to standard James formula (James, 1995).

Energy Value = (Crude protein × 4) + (Total carbohydrate × 4) + (Crude fat × 9)

3.7 Microbiological Analysis

3.7.1 Total viable count

Total Viable Count was measured by plate count agar medium by a standard procedure (Atallah, 2015). One ml of instant mango drinks powder sample was homogenized using vortex mixer (VM-300, Taiwan) with 9 ml sterile peptone water to obtain first dilution. One ml of the sample from a selected dilution was pour-plated in duplicate and incubated for 24 hours at 37°C. The enumeration of bacteria was performed using digital colony counter and the result was expressed as colony forming units per ml (CFU/ml).

3.7.2 Salmonella

Salmonellae continue to be a major concern for the dairy industry because these bacteria have caused recent outbreaks of illness and have been isolated from various dairy products in the market place (El-Gazzar and Marth, 1992). Salmonellae are generally not heat resistant and normally grow at 35 to 37°C, but they can grow at much lower temperatures, provided that the incubation time is suitably extended. When Special Kheersa was made, temperatures was 100°C in wich killed all salmonellae present. To minimize problems, dairy products should be held at or below 2 to 5°C at all times. Both conventional and rapid methods are available to isolate salmonellae from dairy products and to identify the bacteria. Salmonellae behave differently in different kinds of dairy products in favourable condition. Spray drying of skim milk killed substantial numbers of salmonellae, but some survivors remained. Dairy

products readily supported growth of salmonellae at room temperature, and neither freezing nor refrigeration for brief periods eliminated salmonellae from dairy products. Use of appropriate hygienic procedures, e.g., Hazard Analysis Critical Control Point system, during processing should reduce the likelihood of salmonellosis outbreaks associated with dairy products.

3.7.3 *E. coli*

E. coli, test portion, initial suspension and sufficient number of dilutions were made following the standard method. Double-and single-strength Lauryl sulfate tryptase broth, EC broth and Brilliant green lactose bile broth were made as confirmation media in McCartney bottle or screw cap tube with inverted Durham tube. Three tubes of double-and single-strength liquid selective enrichment medium were then inoculated with a specified quantity of the test sample or with a specified quantity of an initial suspension and incubated at 30°C or 37°C for 24 hr. or 48 hr. A series of tubes of the confirmation medium were inoculated with the cultures from the tubes of double-and single-strength selective enrichment medium in which gas formation or opacity preventing the detection of gas formation has been noted. The most probable number of coliforms per milliliter or per gram of sample (i.e., the MPN) was calculated from the number of tubes in the new series showing gas formation. A table for determination of most probable numbers was used (Feng et al., 2002).

3.8 Organoleptic evaluation

Prepared Special Kheersa were subjected to sensory evaluation by 10 persons. The panelists comprised of female and male members including teachers and students of CVASU who had previous experience on dairy products evaluation. The evaluation of Special Kheersa was carried out using a score card developed for the purpose. Score card was prepared keeping in view the quality characteristics of the products. Descriptive terms were given to various quality attributes like appearance/ color, flavor, consistency and general acceptance (Shewfelt, 1999). Evaluation was done at room temperature in the laboratory of the department of Food Processing and Engineering, Chattogram Veterinary and Animal Sciences University (CVASU). Each panelist scored samples independently and recorded the scores on the sheets provided. The scale was arranged such that: Like extremely = 9, Like very much = 8, Like moderately = 7, Like slightly = 6, Neither like nor dislike = 5, Dislike slight = 4, Dislike moderately = 3, Dislike very much = 2, Dislike Extremely = 1. While scoring,

highest score (9) was assigned to most preferred characteristic and least score (1) to the least desired characteristic. This method does not, of course, reflect actual consumer perception, but it does strongly indicate attributes which a good quality product should possess.

3.9 Statistical tools to be used for data analyses

Statistical analysis Data (proximate composition and sensory evaluation) were determined and stored in Microsoft Excel 2013 spread sheet to evaluate statistical analysis. All samples were in three replicates. Descriptive statistics (mean, standard deviation) were done for proximate composition and sensory evaluation of Special Kheersa. Data were sorted, coded and recorded in IBM SPSS Statistics 16. After that statistical analysis were conducted. Proximate composition and sensory evaluation data were analyzed by using One-way ANOVA procedures to assess significant level of variation at 95% confidence interval.

CHAPTER-4: RESULTS

4.1 Proximate Composition of Special Kheersa

The proximate composition of four formulated Special Kheersa was showed in the table 4.1 (ME±SD). Formulation T_4 (0.5% psyllium husk+3% malta peel powder) had the lowest moisture content (60.3±0.2) % whereas Formulation T_1 (Control) had the highest value (64.6±0.06) %. The highest value of ash content (2.15±0.01) % was found in the Formulation T_4 and the lowest value (1.38±0.02) % was for Formulation T_1 . Protein content was slightly higher (5.4±0.10) % in Formulation T_1 whereas lower value (4.5±0.15) % was found in Formulation T_4. Fiber was found in the largest amount (4.5±0.05) % in Formulation T_4 and lowest amount (2.9±0.03) %. Descriptive statistics and Post hoc Tukey test in One-way ANOVA procedures were conducted to analyze data statistically at 5% level of significance.

Table 4.1 Proximate analysis of Special Kheersa

Parameter	T_1	T_2	T_3	T_4	Level of sign.
Moisture (%)	64.6 ± 0.06^{a}	62.4 ± 0.15^{b}	61.4 ± 0.10^{c}	60.3 ± 0.2^{d}	**
Protein (%)	5.4 ± 0.10^{a}	4.8 ± 0.07^{b}	4.7 ± 0.05^{bc}	4.5 ± 0.15^{d}	*
Fat (%)	8.4 ± 0.02^{a}	7.9 ± 0.02^{b}	7.7 ± 0.01^{c}	7.5 ± 0.03^{d}	**
Carbohydrate (%)	17.4 ± 0.02^{d}	19.2 ± 0.02^{c}	20.1 ± 0.03^{b}	21.2 ± 0.02^{a}	**
Fiber (%)	$2.9\pm.03^{d}$	3.7 ± 0.02^{c}	4.1 ± 0.03^{b}	4.5 ± 0.05^{a}	**
Ash (%)	$1.38\pm.02^{d}$	1.76 ± 0.01^{c}	$1.97\pm.02^{b}$	2.15 ± 0.01^{a}	**
Energy (Kcal/100g)	166.09 ± 0.03^{d}	167.69 ± 0.04^{c}	168.86 ± 0.02^{b}	169.73 ± 0.04^{a}	**

** Significant at P <0.01; * Significant at P <0.05; Values followed by different superscript letters denote a significant difference; comparison done across formulation

Legends: T1=Formulation 1(Control), T_2=Formulation2 (Added 0.15% psyllium husk+3% Malta peel powder), T_3=Formulation 3(0.25% psyllium husk+3% Malta peel powder) and T4 =Formulation 4 (0.5% psyllium husk+3% Malta peel powder).

4. 2 Microbiological evaluation of the Special Kheersa

Microbiological characteristics are indicators of safety, quality and shelf life of prepared Special Kheersa. Total viable count, Coliform, *E. coli*, Salmonella count of the Special Kheersa were determined at 0, 1 day, 2 days and 3 days. Results obtained are shown in Table 4.2.

Table 4.2. Microbiological Evaluation of the Special Kheersa

Sample	TVC				E. coli	Salmonella
	0	**1**	**2**	**3**		
T_1	1.7×10^2	1.8×10^3	1.9×10^3	1.6×10^4	ND	ND
T_2	1.6×10^2	1.7×10^3	2.0×10^3	1.3×10^4		
T_3	1.8×10^2	1.6×10^3	1.8×10^3	1.5×10^4		
T_4	1.2×10^2	1.3×10^3	1.7×10^3	1.3×10^4		

ND= Not Detectable

Legends: T1=Formulation 1(Control), **T_2**=Formulation2 (0.15% psyllium husk+3% Malta peel powder), **T_3**=Formulation 3(0.25% psyllium husk+3% Malta peel powder) and T4 =Formulation 4 (0.5% psyllium husk+3% Malta peel powder).

Table 4.2 revealed that data regarding total viable count, total coliform and Salmonella count in Special Kheersa sample T_1, T_2, T_3, T_4. Each sample were enumerated at 0, 1 day, 2 days and 3 days of storage after processing of Special Kheersa. In all cases, total viable count was detected and total coliform, *E. coli* and Salmonella were not detected.

Table 4.3 Sensory evaluation of Special Kheersa

Sensory attributes	Sample				
	T_1	**T_2**	**T_3**	**T_4**	**Level of Significant**
Appearance	5.7 ± 0.67^{c}	7.1 ± 0.56^{b}	8.0 ± 0.66^{a}	7.5 ± 0.84^{ab}	**
Color	5.5 ± 0.85^{b}	8.1 ± 0.57^{a}	8.4 ± 0.52^{a}	7.8 ± 0.63^{a}	**
Flavor	5.8 ± 1.03^{b}	7.8 ± 0.78^{a}	8.2 ± 0.63^{a}	7.5 ± 0.52^{a}	**
Consistency	6.8 ± 0.63^{a}	7.5 ± 0.53^{a}	7.5 ± 0.71^{a}	7.3 ± 0.48^{a}	*
Overall acceptability	5.9 ± 0.74^{b}	7.5 ± 0.53^{a}	8.0 ± 0.67^{a}	7.5 ± 0.52^{a}	**

** Significant at P <0.01; * Significant at P <0.05; Values followed by different superscript letters denote a significant difference; comparison done across formulation

Legends: T1=Formulation 1(Control), **T_2**=Formulation2 (Added 0.15% psyllium husk+3% Malta peel powder), **T_3**=Formulation 3(0.25% psyllium husk+3% Malta peel powder) and T4 =Formulation 4 (0.5% psyllium husk+3% Malta peel powder).

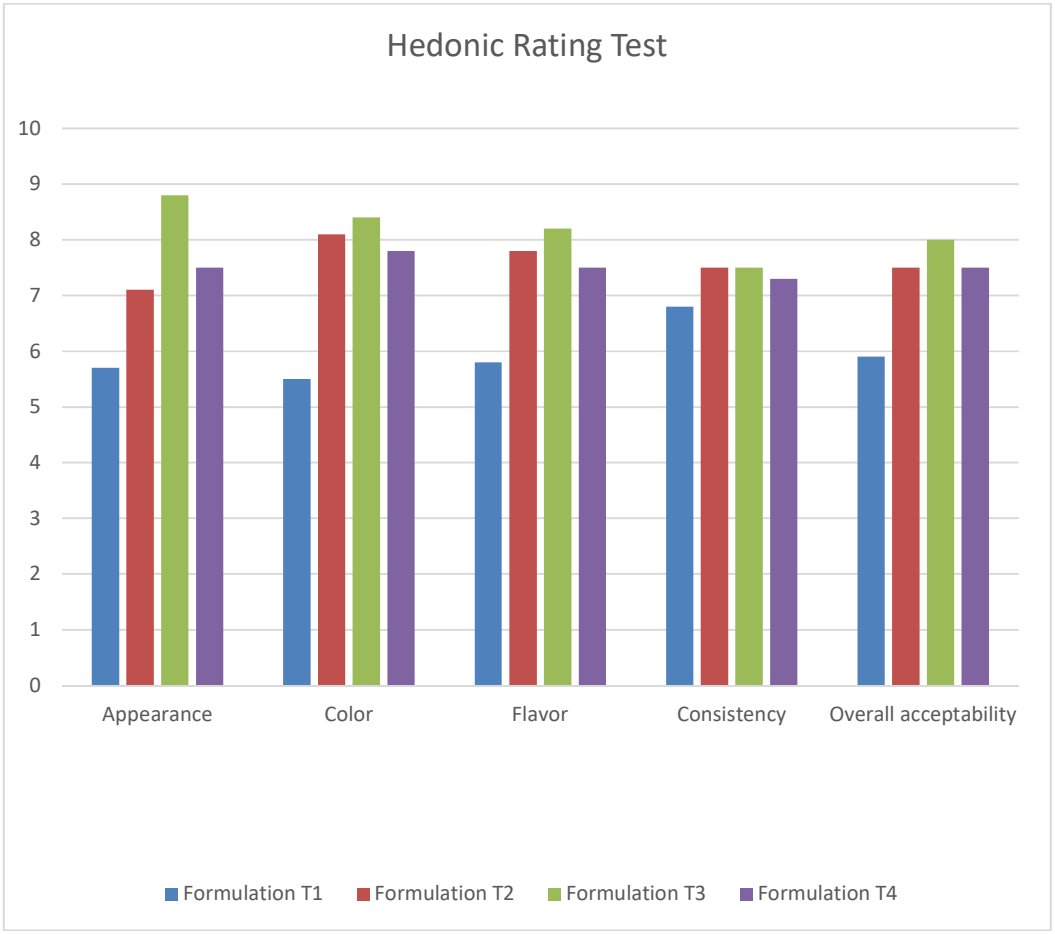

Figure 4.1: Descriptive attributes of all samples of Special Kheersa

CHAPTER-5: DISCUSSION

5.1 Proximate analysis of Special Kheersa

Special Kheersa was prepared from fresh cow milk with constant level of sugar (8% by volume of the ingredients) and different levels of other ingredients such as psyllium husk, bread crumb and malta peel powder (Munagapati and Kim, 2016). The proximate analysis of the product indicated the increase trend of carbohydrates, fiber & ash contents as the proportion of psyllium husk and malta peel powder in the blend. Before used the psyllium husk, it was cleaned very well so that there was not peresnt any dust product.

The malta peel which was used in the Special Kheersa was prepared carefully. For the preparation of malta peel powder, the peel was blanching to stop the enzymatic actions which can cause loss of flavor, color and texture (Devi et al., 2014). The malta peel also contain pectin which helped to create thickness and gave more palatability of the product (Milind and Dev, 2012). The malta peel also gave the attractive color and flavor of the Special Kheersa.

Moreover, the moisture content of the Special Kheersa is 61.4% which was similar value due to the normal range of moisture in Kheersa is (60-65) % (Pariskar et al., 2015**).** So our experiment followed the normal moisture value of Special Kheersa. Moisture content is an important factor in maintaining food quality because increase moisture facilitates the growth of microbes and ultimately destroy quality in a short time. Since the product Kheersa contain high amount of moisture (Kumar et al., 2005), self-life is not a long time. It's quality remains very good upto 16 hours in room temperature (25^0 C) and in chilling condition (5^0C) it can be storage for 0 to 3 days.

Protein is an importent part of food. Protein is crucial to good health (De Wit, 1998). In fact, the name comes from the Greek word proteos, meaning "primary" or "first place." Proteins are made up of amino acids that join together to form long chains (Suzuki, 2007). Proteins do most of their work in the cell and perform various jobs.It is helpful for growth and maintenance of human body.Protein content of Special Kheersa is about 4.7 % which was slightlty lower than than the normal kheer (5.10 to 5.7%) for the addition of pistachio nut, malta peel powder and psyllium husk.

Dietary fiber is an essential component of a healthy diet (Charalampopoulos *et al.,* 2002).The Special Kheersa was cotain 4.1% fiber which is higher than the normal kheer (2.5 to 3%). The fibre content became higher due to addition of psyllium husk, malta peel powder, bread crumb and pistachio nut.Because**,** good sources of dietary fiber include whole grains, fruits and vegetables, as well as nuts and legumes. Fiber in food has been shown to reduce the risk of various medical conditions (Franceschi et al., 2001). The suggested benefits of fiber is to reduce breast cancer, type-2 diabetes, obesity, diverticular disease, hyperlipidemia or high blood cholesterol.

The fat percentage of the Special Kheersa is about 7.7% witch is slightly lower than the normal kheer. The normal kheer fat content is (8.5 to 10) %. Scine the kheersa is generally used as a dessert food item, it is helpful for the human body (Jha et al., 2002). Specially it is good for the obese people. Obese individuals are advised to use Special Kheersa as theirs will. It is also a good supplementary food for malnourished children and adults.

The carbohydrate content of the Special Kheersa is 20.1 % where the local kheer contain 15 to 18%. Carbohydrate is also a good source of energy (Burke et al., 2006). Due to the addition of psyllium husk, malta peel powder, bread crumb and pistachio nut carbohyrate content become slightly high. Total energy obtain from 100g Special Kheersa is 168.86 Kcal.

5.2 Microbial analysis of Special Kheersa

In this study, microbiological investigation was also done for the prepared Special Kheersa formulation T_1, T_2, T_3, T_4. Investigation included Total Viable Count (TVC), E.coli and Salmonella. . Each sample were enumerated at 0, 1 day, 2 days and 3 days of storage after processing of Special Kheersa. In all cases, total viable count was detected and total *E. coli* and Salmonella were not detected. After preparation the product quality was good up to 3 days in chilling condition. After 3 days, the hygienic indicator organisms were gradually increased and the product quality became deteriorating.

5.3 Sensory evaluation of the Special Kheersa

Sensory evaluation is also an important part of quality evaluation of a product. For the addition of Malta peel powder the appearance of the product was so good and attractive. The taste of the product also desirable with increasing the color and flavor. For the addition of psyllium husk and pistachio nut gave the desirable mouth feel and increase the fiber content of the product. The results of sensory evaluation of the Special kheersa seen that Special kheersa had high sensory ratings, overall acceptability score being 8.0 on a 9-point hedonic scale. Special kheersa being a product, processed at very high temperature at 100^0C, had slightly lower scores for color, texture, flavor and overall acceptability during storage at 5^0C up to 3 days.

CHAPTER-6: CONCLUSIONS

This study has shown that addition of psyllium husk and malta peel powder with cow milk improved the nutritional quality of the Special Kheersa. At the same time the microbial presence of salmonella and *E.coli* growth were strictly prohibited. The use of Psyllium husk, malta peel powder and pistachio nut improved the fiber quantity of the Special Kheersa. This study has also opened a new era of the food loving people as well as diabetic patients. Special Kheersa produced from such composites will not only increase savings in foreign exchange for countries like us but also improve utilization of locally available cow milk and lead to enhanced nutrient intake by the consumer.

Additional psyllium husk and malta peel powder increased the appearance, color and flavor of the developed product Special Kheersa which is health effective. Well furnished dairy industries can accept the new technology for further the new product development and marketing.

CHAPTER-7: RECOMMENDATIONS & FUTURE PERSPECTIVES

The global consumption of dairy products has greatly increased during recent decades, due to a number of distinct factors. Foremost among these factors is the growing knowledge that milk and milk product with psyllium husk and malta peel constitutes are important and healthy part of the human diet, mainly owing to the presence of fiber which play an essential role in human health.

Present study is conducted to investigate the formulation and quality (Proximate, microbiological, sensory) evaluation of Special Kheersa. In the place where modern facilities of processing do not exist, this technology can be easily achieved in home and industrial level. Establishment of small-scale processing unit at grower's level could utilize these available ingredients for processing of Special Kheersa which will be helpful to get this product in any time. Formulation and quality evaluation of Special Kheersa suggests the following recommendation:

- The proximate composition of Special Kheersa should be evaluated.
- Prepared the product maintaining hygienic condition.
- There should be create awareness about the importance of the dairy product being a scope for food industry.

Modern packaging and storage condition would be developed for the betterment of Special Kheersa product.

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Appendices A: Photo Gallery

Appendix A1: Pictorial presentation of processing of Special Kheeersa

Cow milk

Psyllium husk

Bread crumb

Blanching of Malta

Drying

Grinding

Malta peel powder

Pistachio nut

Mixing

Special Kheersa

Organoleptic Evaluation

Appeddices A: Photo Gallery

Appendix A2: Pictures of laboratory activities

Weighing

Ash

Fibre

Protein

Titration

Microbial Test

Appendix B: Hedonic Rating Test (Special Kheersa)

Name of Tester……. Date……

Please taste these samples and check how much you like or dislike each one on four sensory attributes such as Appearance, Color, Flavor, Consistency and Overall Acceptability Use the appropriate scale to show your attitude by checking at the point that best describes you're feeling about the sample please give a reason for this attitude remember you are the only one who can tell what you like. An honest expression of your personal feeling will help me.

HEDONIC	**APPEARANCE**				**COLOR**				**FLAVOR**				**CONSISTENCY**				**OVERALL ACCEPTABILITY**			
	Sample				**Sample**				**Sample**				**Sample**				**Sample**			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Like extremely																				
Like very much																				
Like moderately																				
Like Slightly																				
Neither like nor dislike																				
Dislike slightly																				
Dislike moderately																				
Dislike very much																				
Dislike extremely																				

Extra comments on each sample if any:

N.B. Overall scale used: 9= like extremely; 8=like very much, 7= like moderately; 6= like slightly; 5= neither like nor dislike; 4= dislike slightly; 3= dislike moderately;2= dislike very much; 1= dislike extremely

……..

Signature of Judge

Brief Biography

Abdullah Al Mamun passed Secondary School Certificate Examination(SSC) in 2009 Ulipur M.S School & College, Kurigram and Higher Secondary School Certificate Examination (HSC) in 2011 from Cantonment Public School & College, Rangpur. He obtained his B.Sc.(Hon's) in Food Science and Technology from the Faculty of Food Science and Technology of Chattogram Veterinary and Animal Sciences University, Khulshi-4225, Chattogram, Bangladesh. Now, he is a candidate for the degree of Master of Science in Applied Human Nutrition and Dietetics under the Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University (CVASU). His research interests are development of food products which have health effectiveness.