“Process optimization for preparation of low calories chia kheer”

Dissertation report 2

Submitted by,

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UNDER THE GUIDANCE

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MAY 2018

CERTIFICATE

This is to certify that **Pushpendra Dev Sharma** (Registration No.11719509) has personally completed M.Sc. dissertation 2 entitled, **"Process optimization for preparation of low calories chia kheer"** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of pre-dissertation has ever been submitted for any other purpose at any University.

The project report is appropriate for the submission and the partial fulfilment of the conditions for the evaluation leading to the award of Master of Science in Food Technology.

Date: MAY 2018

Signature of Supervisor

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DECLARATION

I hereby declare that the work presented in the Dissertation 2 report entitled **"Process optimization for preparation of low calories chia kheer"** is my own and original. The work has been carried out by me at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India: under the guidance of Dr. Anil Panghal, Associate professor (Food Technology) at School of Agriculture, , Lovely Professional University, Phagwara, Punjab, India, for the award of Degree of Master of Science in Food Technology.

Date:

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I certify that the above statement made by the student is correct to the best of my knowledge and belief.

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CHAPTER 1 INTRODUCTION

In India there are many traditional desserts, Kheer is very popular in whole of the country, because of its delicious taste, greater nutritional value and lower cost than other products. It is prepared by partially concentration of whole milk in a karahi by giving it direct heat, together with sugar and rice with the addition of some nuts as cashew nut, almonds, pistachio and cardamom.

Several works on development of kheer by incorporating different raw materials:-

TABLE 1: Types of kheer by using different raw materials

Raw material	Product	References
Pulse based kheer	Bengal gram kheer, Green gram kheer	(P. Nazni and C. Sureshkumar 2011)
Cereal based kheer	Rice kheer, Pal kheer	(De *et al*. 1976)
Tuber crop based kheer-	Pumpkin kheer	(Shaikh *et al*. 2015)
Seed based kheer-	Cowpea seed kheer	(Gupta *et al*. 2014)

Chia seed (*Salvica hispanica L*) is annual herb. Mainly found in Northern Guatemala and Mexico, which blooms in summer season. Chia seeds are very rich in nutritive qualities, it contains omega-3 and omega-6 fatty acids, vitamins, soluble dietary fibres, minerals and appriciable amount of phytochemicals and proteins. Because of special nutritional attributes it helps in prevention from various non-communicable diseases such as cardio vascular diseases, hypertension etc. It also shows antioxidant and free scavenging activity. These qualities make chia seeds a novel food.

Chia seeds are typically flat, small and oval in shape. The thickness, length and width of these seeds are 2.0- 2.5 mm, 1.2- 1.5 mm and 0.8- 1.0 mm respectively. Chia seeds are of two type black seeds and white seeds, there is slightly difference in their composition. White chia seeds little bit bigger than black seeds. The yield of white chia seeds oil is about 33.8% and black chia seeds oil is about 32.7%. (Suri *et al*. 2016)

Inulin is a non-digestible carbohydrate made up from residues of β(2, 1)-linked fructosyl that are ending with a glucose residue and it is found in most of plants as storage carbohydrate. Nowadays, this carbohydrate is being used widely in food market as in bakery products, cereals etc. inulin can be used in the place of sugar (with the combination of sweeteners that have high intensity), in the place of fat and also in modification of texture. For replacement of fat in dairy products (low-fat products) inulin is extremely appropriate as it may provide to a better mouth-feel. Inulin significantly changes the texture of milk products and also may significantly impacts their sensory properties because inulin enhances its effect on the structure and texture of product. (Meyer *et al*. 2011)

Stevia can use as substitute of sugar as it used as sweetening agent in production of various food. It is plant found in South America, South Korea and China and also known as sugar plant. Stevia contains sugar i.e. rebaudioside A (Reb A), is functional substance of stevia. Sweetness of stevia is 250 to 300 times higher than sugar. Stevia doesn't provide energy. In some cases high concentrations extracts of stevia may be bitter. There is negligible effect on level of glucose in blood by consuming stevia, it helps people to get diet that is carbohydrates controlled. Powder of stevia leaf is significantly capable in absorption of fat, since fat retains flavour and enhances the mouth-feel. (Ozdemir *et al*. 2015)

The purpose of study about kheer, chia seeds, inulin and stevia is to production of low calories chia kheer. As inulin and stevia leaves have lesser amount of calories so that we can use them as the sweetener, fat absorbance, for thickness, creaminess, texture modifier and good mouth feel.

CHAPTER 2 PROBLEM BACKGROUND

To the best of our knowledge surplus amount of dairy products are available in food market, but with continuous increase in demand of more nutritious products, there is a need of developing a novel product that is rich nutritive properties and of lower cost. Chia seeds have excellent nutritive qualities and excellent source of omega 6 fatty acids and omega 3 fatty acids, proteins, soluble dietary fibres, vitamins, minerals and phytochemicals, so its application in food sector is very significant. In this research we are developing low calories kheer, by incorporating chia seed, stevia and inulin into kheer. Chia seed kheer can be consumed as low calories and high nutritive food.

Chia seeds

Chia seeds has an appreciable amount of omega-3 fatty acids and omega-6 fatty acids, dietary fibre, proteins and phytochemicals and hence are recognized as a novel food (Suri *et al*. 2016). The chia plant being sensetive to daylight produces black seeds and white seeds. White coloured chia seeds are less common than black seeds. There is a slight difference between the two seeds. Moisture content of white and black chia seeds is 6.6% and 7.2% repectively. White seeds are thicker, broader and larger than the black chia seeds. Composition of proteins and fatty acids of both the chia seeds varies significantly.

TABLE 2: Meannutritional composition of chia seeds

Chia seed's Nutrients	**Amount**
Energy	486 Kcal/100g
Protein	16.54 g/100g
Fat	30.74 g/100g
Carbohydrates	42.12 g/100g
Moisture	5.80 g/100g
Dietary fibre	34.4 g/100g
Total Phenols (gallic acid equivalent /g)	0.97 – 0.99 mg/g

Bushway *et al*. (1981) analyzed that chia seeds are good source of oil. Chia seed oil composed of more than 90% of triglycerides. It contains 23% protein that can obtain by etraction of oil. A clear mucilagenous gel is extracted into the water when chia seeds are soaked in water.

Taga *et al*. (1982) investigated that Chia seeds are also a source of natural lipid antioxidants. Methanolic extract and aqueous extract, chia seeds (deffated) have strong free radical scavenging activity. Flavonol glycosides, chlorogenic acid and caffeic acid cause the crucial antioxidant activity in non-hydrolyzed extract, whereas in hydrolyzed extracts antioxidants were flavonola glycones/kaempferol, quercetin and myricetin and caffeic acid.

Marineli *et al*. (2014) suggested that Chia seeds and chia seeds oil are functional ingredients with high antioxidant activity in food product.

Kheer

Srinivasan and Anantakrishnan (1964) said that the kheer is intended for immediate consumption. It is made by concentrating whole milk to a ratio of 3:1. The concentration was mostly done with the addition of sugar at the rate of 5% to 8% of volume of milk.

De *et al*. (1976) made kheer on large scale by boiling milk in a stainless steel jacketed kettle till the concentration was reached up to 1.9 to 2.0 with the addition of sugar. Kheer prepared from 4.0% fat milk with 2.5% rice and 5.0% sugar was found to be the best.

Singh *et al*. (1987) described a simple preparation method of kheer. Kheer was made with milk, rice and sugar in the ratio of 14 litre milk, 840 gm rice and 2.25 kg sugar. Four hundred grams of each preparation was transferred to 1 lb jar size cans, steam exhausted and then thermal processed as require for the different experiment.

Sankhla et al. (1990) reported that the average proximate composition of kheer prepared was follows.

TABLE 3: Proximate kheer composition, prepared from buffalo milk

Constituents	**Kheer prepared from buffalo milk (Per cent)**
Moisture	67.00
Fat	11.60
Protein	5.30
Ash	0.93
Total Carbohydrate	15.17

Niturkar (1989) reported the kheer preparation from skim milk containing 0.75 per cent fat, 12 per cent total solids and skim milk fortified vermicelli. Three levels of vermicelli i.e. 4, 8 and 12 per cent, three levels of sugar i.e. 8,12 and 16% have been tried. The combination of 8% vermicelli and 12% sugar was found to be significantly superior with respect to major characteristics viz flavour, sweetness and overall acceptability.

Pariskar *et al*. (2015) prepared Kheer from soy milk with the blending of buffalo milk, and noted that in the blend the increased level of soy milk enhance the moisture and titrable acidity and protein contents. Addition of soy milk in mixture decreases the contents of fat, total solids, total sugar and ash .

Gupta *et al*. (2014) prepared instant kheer mix with the addition of malted wheat flour and cowpea with incorporation of skim milk powder, rice and sugar, and estimated that, these incorporation make kheer more nutritious.

Jha *et al.* (2011) suggested that the shelf-life of kheer can significantly influenced by process based on thermal processing in-pouch by applying a rotary retort and optimised rice and milk solids ratio i.e. 0.18–0.52 and levels of total milk solids i.e. 16–26% stimulate taste, appearance and textural attributes in product.

De *et al.* (1976) suggested on giving sterilization treatment to the canned product resulted in significant enhancement of the shelf life under refrigerated storage. Under similar conditions of storage addition of Nisaplin showed a synergetic effect on shelf life of the product.

Adil *et al*. (2015) reported that sensory characterstics of pumpkin based kheer i.e. texture colour, flavour, appearance and overall acceptability is affected by the factors like treatments and storage time. As the storage time advanced there is decrease in sensory properties of the kheer.

Phytic acid

According to the Egli *et al*. (2002) Phytic acid inhibits the absorption of trace elements and minerals which are present in all legume seeds, cereals and grains. Phytic acid binds with functional groups of molecules that are positively charged because of its negative charge. Complexes are being formed by phytic acid with minerals. Germination and soaking reduce the content of phytic acid and increase the phytase activity in a broad range of seeds and grains but it is not very effective. Not soaking but germination, increased activity of phytase 3 to 5 times in some legume seeds and cereal grains whereas the impact on the content of phytic acid was not noticeable in most materials tested. Absorption of zinc and iron is increase by the degradation or removal of phytic acid. Phytase enzyme can degrade the phytic acid.

Inulin

Franck (2002) recommended that Inulin is functional food ingredient it provides a distinctive nutritional properties combination and also some critical technological benefits. It is present in diffrent fruits and vegetables. For industrial applications it can be obtained from chicory roots. In food composirtion, inulin may occur significantly improvement in organoleptic properties. Incorporation of inulin improves both mouth-feel and taste in food production. The stability emulsions and foams improve by its lower solubility and in the gel form in water inulin shows some fat-like features. When chicory inulin used in the place of Fat and carbohydrate, it shows significant effect on taste and texture and also enhancing the nutritional property of product.

Tarrega and Costell (2005) reported the influence on the sensory characteristics of fat-free dairy desserts by the inulin incorporation. Inulin addition with Skimmed milk showed higher consistency than the skimmed milk and the whole milk. Sweetness, thickness and creaminess can be increased by the incorporation of inulin to the fat free dairy dessert.

Meyer *et al*. (2011) described that inulin improves texture of most of the dairy products and thus is one of the most significant application sector for it. It can be utilized as the fat replacer

for replacement for the characterstics of fat such as mouthfeel and creaminess. These may lead to changes in the rheological effect of the food products.

Stevia

According to Giri *et al*. (2012), Stevia is sweetener present in nature. stevia present in leaves of plant Stevia rebaudiana. Sweetness of refined powder of stevia extract is 130 to 300 times more than table sugar. It is heat tolerant and can withstand upto to 200°C. The contents of stevia as stevioside that is a sweetening compoud, as a principal diterpene glycosides are about 250–300 times sweeter than the sugar. Sweetness of Rebaudioside-A is about 400 times more than sucrose. Rebaudioside-B, C, D, E and dulcoside are also sweet constituents. These compounds has only dissimilarity in their glucose side chain, again it also prevents diabetes, weight reduction of the body, and prevents decaying of tooth, and increases gastrointestinal fuctions etc.

They used 0.07, 0.06 and 0.05% of the refined stevia powder in the place of 70%, 60% and 50% sugar respectively in the Kulfi production. At upper levels of the replacement of sugar, they found that there was a significantly reduction in specific gravity, and in rate of melting, in the percentage of carbohydrates and total content of calories, increase in the point of freezing, fat, moisture percentage, ash, hardness and protein. Kulfi was made by the replacement of 50% content of sugar with stevia which was considered on average with the control in sensory characteristics. But above 50% concentration of stevia leads to bitterness in the product.

Ozdemir *et al*. (2015) developed ice cream and used stevia as a sweetening agent, and also noted the effect on sensory characterstics, chemical and physical properties and the of the ice-creams by the incorporation of stevia. They analyzed four samples of ice-cream which were produced by the using of stevia and sucrose as sweetening agent (1.Sucrose+Plain, 2. Sucrose+cocoa, 3. Stevia+plain and 4. Stevia+cocoa). The highest ratio of overrun (20.17 %) was observed in the Stevia+cocoa sample. The viscosity of this sample is 20.29 Pa .s at 20 rpm which were more than other samples.

CHAPTER 4 OBJECTIVES

1. To standardize the process for production of chia kheer.
2. To standardize the process for production of low calorie chia kheer.
3. To study the shelf life of the developed optimized chia kheer.

- **Objective 1: To standardize the process for production of chia kheer.**

Chia seed will be subjected to different treatments:

1. Soaking (Sandoval-oliveros and Paredes-lopez 2012)
2. Germination (Egli *et al*. 2002)
3. Roasting (Yoshida and Takagi *et al*. 1997)

1. Soaking

Soaking of chia seed will be done to reduce the level of anti-nutrient component present in chia seeds. Phytic acid acts as anti-nutrient in chia seed (Rebeca *et al*. 2006). Seeds will be soaked in water in the ratio of 1:10 w/v and analyzed at different time intervals. (Sandoval-oliveros and Paredes-lopez 2012)

TABLE 5: The effect on phytic and tannin content with different soaking time

S. No.	Soaked time (in Hrs.)	Phytic acid content	Tannin content
1.	1		
2.	2		
3.	3		
4.	4		
5.	5		
6.	6		
7.	7		
8.	8		

2. Germination

Chia seeds will be germinated after soaking for 24 hrs, 48 hrs, and 72 hrs. The wight of seeds before germination and after germination will be noted and further analysed for the estimation of phytic and tannic acid content. (Egli *et al.* 2002)

TABLE 6: The effect phytic and tannin with different germination time

S. No.	Germination time	Phytic acid content	Tannin content
1.	24 hrs.		
2.	48 hrs.		

	3.	72 hrs.

3. Roasting

Single layer of Chia seeds will be placed in a Pyrex petri dish (8·0 cm in diameter) and roast. (Yoshida and Takagi *et al*. 1997)

TABLE 7: Roasting of chia seeds on different Time and Temperature

S. No.	Temperature in (℃)	Time in (Mins.)
1.	160	5
2.	180	10
3.	200	15
4.	220	20
5.	250	25

1. **Chemicals analysis :-**
    A. Phytic acid (Egli *et al*. 2002)
    B. Total phenolic content (Marineli *et al*. 2014)

2. **Antioxidation activity**
    A. DPPH free radical scavenging activity (Marineli *et al*. 2014)
    B. ABTS free radical scavenging activity (Khan *et al*. 2012)
    C. FRAP assay (Hassan *et al*. 2013)

3. **Proximate analysis:**
    A. Moisture (Marineli *et al*. 2014)
    B. Ash contents (Marineli *et al*. 2014)
    C. Protein (Marineli *et al*. 2014)
    D. Fat (Marineli *et al*. 2014)
    E. Soluble dietary fibre, insoluble dietary fibre, Total dietary fibre (Marineli *et al*. 2014)
    F. Fatty acid (Marineli *et al*. 2014)

From the analysis that will be performed, best outcomes will be considered for further experiment.

Chia seeds will be incorporate in milk and will be heated until the appropriate consistency. Sugar will be added for the sweetness along with nutmeats and powder of cardamom for flavour. Mixture will be heated till the appropriate concentration, and will be analyze.

1. **Proximate analysis:**
   A. Moisture (Gupta *et al*. 2014)
   B. Ash contents (Gupta *et al*. 2014)
   C. Protein(Gupta *et al*. 2014)
   D. Fat (Gupta *et al*. 2014)
   E. Soluble dietary fibre, insoluble dietary fibre, Total dietary fibre (Gupta *et al*. 2014)

2. **Chemicals analysis :-**
   A. Phytic acid (Egli *et al*. 2002)
   B. Total phenolic content (Marineli *et al*. 2014)

3. **Antioxidation activity** (Marineli *et al*. 2014)
   A. DPPH free radical scavenging activity (Marineli *et al*. 2014)
   B. ABTS free radical scavenging activity (Khan *et al*. 2012)
   C. FRAP assay (Hassan *et al*. 2013)

Significant outcomes will be considered for further experiment from the analysis that will be performed.

- **Objective 2: To standardize the process for production of low calorie chia kheer**

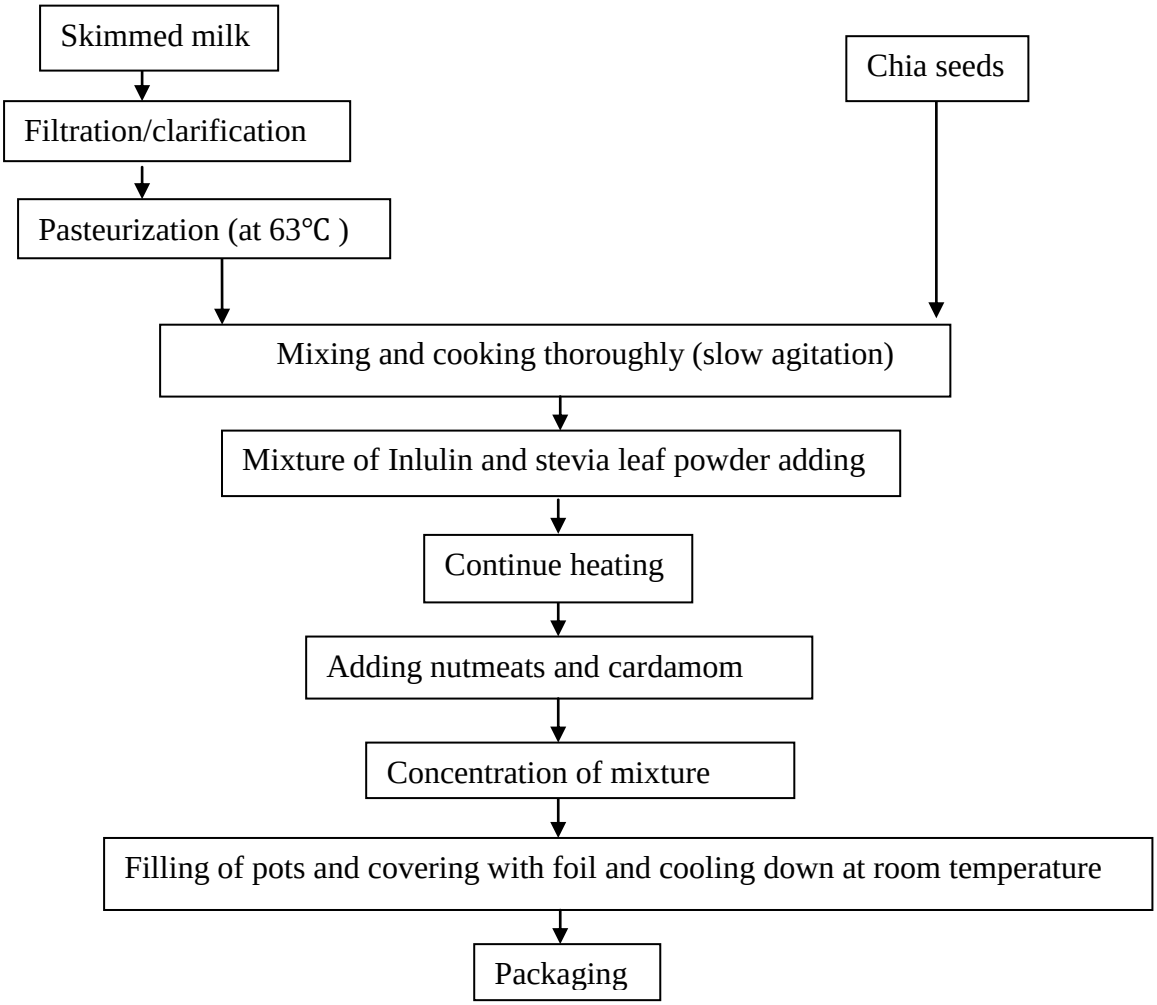
For the production of low calorie chia kheer, skimmed milk, inulin and stevia leaf powder (for sweetness, thickness, creaminess and low calories) will be used.

Inulin and stevia leaf powder will be added and then analyzed in different ratio.

Table 8: Ratio of Inulin and Stevia

Inulin	Stevia
2%	0.06%
4%	0.08%
6%	0.10%
8%	0.12%
10%	0.14%

Chia seeds will be added in skimmed milk. Mixture of chia seed and milk will be heated and cooked thoroughly until the appropriate concentration. Inulin will be added for thickness, and creaminess (Tarrega and Costell, 2006). Stevia leaf powder will be added in the place of sucrose. Mixture of Inulin and stevia will be added in appropriate ratio. Nuts as cashew, almond, pistachio and cardamom powder will be added. Heating and stirring will be continued until the desirable concentration.



1. **Proximate analysis:**
   A. Moisture (Marineli *et al*. 2014)
   B. Ash contents (Marineli *et al*. 2014)
   C. Protein (Marineli *et al*. 2014)
   D. Fat (Marineli *et al*. 2014)
   E. Soluble dietary fibre, insoluble dietary fibre, Total dietary fibre (Marineli *et al*. 2014)
   F. Fatty acid (Marineli *et al*. 2014

2. **Chemical analysis**
   A. Phytic acid (Egli *et al*. 2002)
   B. Total phenolic content (Marineli *et al*. 2014)

3. **Antioxidation activity**
   A. DPPH free radical scavenging activity (Marineli *et al*. 2014)
   B. ABTS free radical scavenging activity (Khan *et al*. 2012)
   C. FRAP assay (Hassan *et al*. 2013)

4. **Sensory analysis:**

   The acceptability of the chia kheer will be measured in terms of sensory qualities as flavour, colour and appearance and texture using 9 point hedonic scale by a panel of 50 trained judges.

   A. Colour and appearance
   B. Flavour and sweetness
   C. Body and texture
   D. Mouth feel
   E. Overall acceptability.

Expression	**Points**
Extremely liked	9
Very much liked	8
Moderately liked	7
Slightly liked	6
Neither disliked nor liked	5
Slightly disliked	4
Moderately disliked	3
Very much disliked	2
Extremely dislked	1

Sample	Color and appearance	Flavor and sweetness	Body and texture	Mouthfeel	Overall acceptability	Remarks (if any)

Suitable results will be considered for estimation of shelf life of the product.

- **Objective 3: To study the shelf life of the developed optimized chia kheer.**

Proximate analysis will be done. The chia kheer will be stored at different temperature (10, 25, 37℃) and physical, chemical and microbiological tests will be analyzed. The chia kheer will be packaged in metalized polyester thick laminate pouches, HDPE and LDPE and will be analyzed.

1. **Proximate analysis:**
   A. Moisture (Gupta *et al*. 2014)
   B. Ash contents (Gupta *et al*. 2014)
   C. Protein(Gupta *et al*. 2014)
   D. Fat (Gupta *et al*. 2014)
   E. Soluble dietary fibre, insoluble dietary fibre, Total dietary fibre (Gupta *et al*. 2014)

2. Chemical analysis

A. Phytic acid (Egli *et al*. 2002)
B. Total phenolic content (Marineli *et al*. 2014)

3. Antioxidation activity

A. DPPH free radical scavenging activity (Marineli *et al*. 2014)
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Moderately disliked	3
Very much disliked	2
Extremely dislked	1

Sample	Color and appearance	Flavor and sweetness	Body and texture	Mouthfeel	Overall acceptability	Remarks (if any)

5. Hydroxy methyl furfural (HMF), Thiobarbituric acid (TBA) value and Free Fatty acid (FFA) will be measured during the storage.

A. HMF (Singh *et al*. 2013)
B. TBA (Singh *et al*. 2013)
C. FFA (Deeth *et al*. 1975)

6. Microbiological analysis:

A. E.coli count– MacConkey (Godbole *et a*l. 2013)
B. Mold and yeast count –Sabouraud Dextrose Agar (Godbole *et al*. 2013)
C. Total viable count– plate count agar by standard plate count (SPC) (Godbole *et al.* 2013)

CHAPTER 6 EXPECTED RESEARCH OUTCOMES

- Chia based kheer acceptable on physio-chemical and sensory levels will be developed.
- The developed product will have acceptable shelf life suitable for possible commercials.

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