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Optimization and shelf life extension of flax seed milk paneer by hurdle technology

Shwetha ShriK.[1,*], GeethaP.[2], VimalaRani[3]
[1]*M.Tech(Foodand Nutritional Biotechnology).DepartmentofFoodProcessEngineering,SRMUniversity,Kattankulathur, Tamilnadu, India*
[2]*DepartmentofFoodProcessEngineering,SRMUniversity,Kattankulathur, Tamilnadu, India*
[3]*KVK,TamilnaduVeterinaryandAnimal Sciences University,Kattupakam,Kanchipuram,TamilNadu,India*

Abstract: *Flax seed milk paneer is a new product developed with the target of providing a nutritional supplement of omega 3 fatty acids to the vegetarian population. Various magnitudes of flax seed milk and standardised milk were used and coagulated using three different coagulants citric acid (2 %), ascorbic acid (2%), and tartaric acid (4%). Based on sensory and textural analysis the best blend was nominated for further studies and analysis. Hurdle technology was applied to the prepared flax seed milk paneer. The hurdles adopted comprised of Water activity ($a_{w)}$, pH, and preservative. Water activity was reduced from 0.99 to 0.95 at 28.5°C and pH values decreased from 5.6 to 5.1. The product was packed in polyethene bags, sealed and stored under refrigerated conditions at 5°C. The sensory scores decreased on storage but the keeping quality and nutritional values of the product did not show considerable conditions.*

Keywords: *Flax Seed Milk, Paneer, Omega 3 Fatty Acids, Hurdle Technology, Water Activity, Sensory Analysis*

I. Introduction

Flax seed is the richest plant source of omega 3 fatty acids. It is an emerging functional food because of its rich contents of α linolenic acid, lignans and fiber. It can contribute to the reduction of several diseases such as diabetes mellitus, atherosclerosis and cancer. Flax seed has a very healthy fatty acid profile with high concentrations of PUFA (73%). (Flax Canada 2015).

Paneer is one of the important Indian traditional heat and acid coagulated product widely used as a vegetarian delicacy (Venkateshaiah 2003).Flax seed milk incorporated paneer will be a promising supplement of omega 3 fatty acids to the vegetarian population. The higher moisture content of this product makes it more to faster spoilage resulting in limited shelf life. Each hurdle like $a_{w,}$ pH and the use of preservatives like delvoacid ,sorbic acid, hydrogen peroxide may help to extend shelf life (Rao 2000).When used in combination at an optimum level without affecting the product quality hurdle technology concept may enhance the shelf life of the product (Leistner 1994).

Present study was done on formulation of flax seed milk paneer and application of hurdle technology to the optimized product for shelf life enhancement.

1.1.Needforthe Study

Flaxseedprovidesoneoftherichestnon-animalsourcesofomega-3fattyacidsmakingitidealforvegetarians.Hencetheaimoftheprojectistodevelop Flaxseedmilkpaneerwithincreasedshelflifebyusinghurdletechnology

1.2. Objectives

- Tooptimizeflaxseedmilkpaneer.
- Tostudythephysiochemical,textural,microbialandsensorycharacteristicsoftheproduct.
- Toincreasetheshelflifeofproductbyapplicationofhurdletechnology.

II. Materials & Methods

2.1. Extraction of Flax Seed Milk

Flax seed (Linumusitatissiumum) were procured from a local super market (Nilgris at Urapakkam) Flax seed milk is extracted by a three step process. The seeds are soaked in hot water at 45°C for 20 minutes to remove the anti-nutritional factors present. The soaked seeds were ground to a fluid consistency using ice cold water at 5°C (500ml of water for 100 gm of seeds). The milk was filtered from the extract by using a muslin cloth.

Table 2.1. Proportions for 1 litre milk:

Standardised Milk	Flax Milk
900 ml	100ml
800 ml	200ml
700ml	300ml
600ml	400ml
500ml	500ml

2.2. Preparation of Flax Seed Milk Paneer and Application of Hurdle Technology

Milk and flax milk were taken in the proportions as mentioned in Table 2.1. The mixture was heated to 98°C with stirring to facilitate uniform mixture .When the temperature drops between 87°C - 90°C the coagulant was added with intermittent stirring till end point was indicated by clear whey solution. Three different coagulants at different strengths were used – citric acid 2% , ascorbic acid 2% and tartaric acid 4% . After coagulation the curds were passed through muslin cloth to drain off the whey and the curds are transferred to the paneer press lined with a muslin cloth subjected to pressing for 20 minutes to obtain a compact block of paneer. Immediately after pressing the paneer is transferred into cold water at 5°C and kept as it is for 45 minutes. The paneer is then cut into small cubes to be utilized for further studies.

Table 2.2. Textural analyzer settings and parameters:

Mode	Measure force in compression
Option	Return to start
Pre-Test Speed	1.5 mm/s
Test Speed	2.0 mm/s
Post-Test Speed	10.0mm/s
Distance	5 mm
Trigger Type	Auto 2.5g
Data acquisition rate	400pps

Textural analysis to check the firmness of the samples were done using Texture AnalyserHDi from Stable Microsystems. Table 2.2 shows the texture analyser settings and parameters. Sensory analysis was done using a 9 point hedonic scale. Based on textural and sensory analysis the best variant was selected and was used for further analysis.

2.3. Water Activity and pH

Water activity and pH were reduced by dipping paneer cubes of 1 cm in stainless steel vessels containing 1 litre of 3% 1 NaCl and 0.1% Citric Acid solution for diffusion at refrigerated conditions at 7°C for 12 hours. After diffusion paneer cubes were taken out and kept on wire gaze for 30 mins to facilitate drainage .Potassium sorbate (0.1%) was used as a preservative (Thakral et al 1990). The water activity and pH reduced paneer was packed in the packaging material (PE) and stored at refrigerated conditions.

2.4. Analytical Methods

Paneer samples were analysed for moisture, fat, protein, pH, ash as per ISI (1981 b). Water activity was measured by using Aqua lab V2.3 water activity meter. pH was determined by using digital pH meter as per the procedure followed by ISI.

The paneer samples were analysed for standard plate count (SPC), Yeast and molds, coliforms (ISI 1981a).

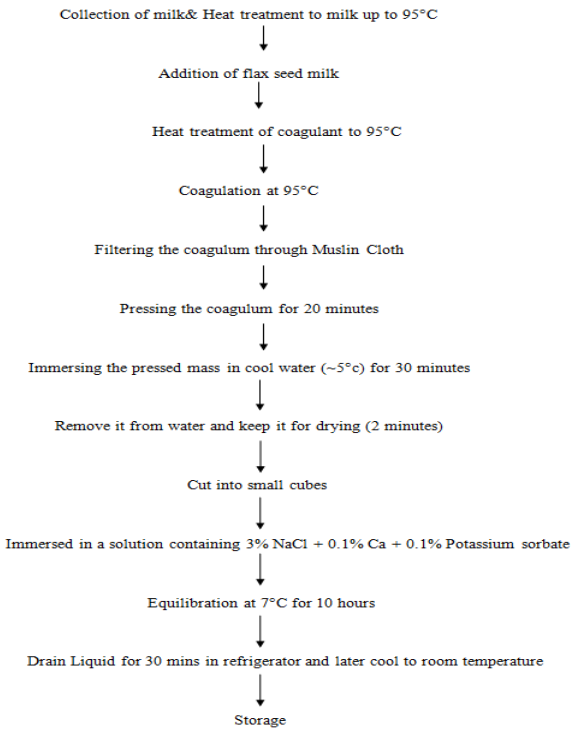

Fig 1. Preparation of flax seed milk paneer by hurdle technology

Accessory:1"sphericalprobe(P/1s)using5kgloadcell
Testsetup:Removethesamplefromplaceofstoragejustpriortotesting.Positionthesamplecentrallyunderthesphericalprobeandthetestiscommenced.

III. Results and Discussion

3.1.StandardisationofFlaxSeed MilkPaneer

Forthestandardizationofflaxseedmilkpaneerthefollowingparametersaremandatorytobeconsidered.Theparametersareproportionsofflaxseedmilk,coagulantused,concentrationofhurdlesusedforshelflifeextension.

Table3.1. ProportionsforFlaxseedmilkpaneer

Sample	Proportions
Sample1	90%Milk+10%Flaxmilk
Sample2	80%Milk+20%Flaxmilk
Sample3	70%Milk+30%Flaxmilk

BasedonProportionandTypeofcoagulant:

3.1.1.ComparisonofSensoryAnalysis ofCitricAcidVariables

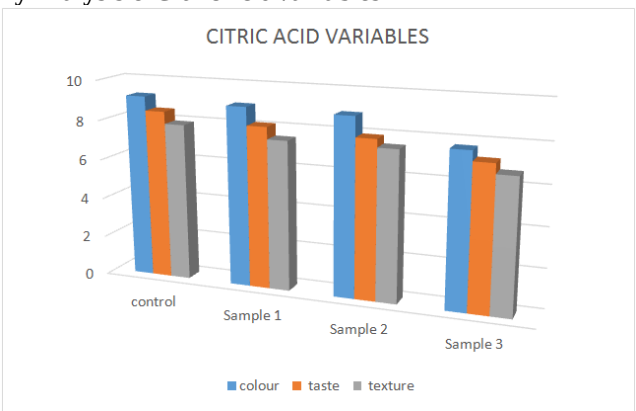

Fig.3.1. Sensoryanalysisoftheproportionscoagulatedwith2%CitricAcid

3.1.2.TextureAnalysis ofCitric Acid Coagulated Flax Seed Milk Paneer Variables

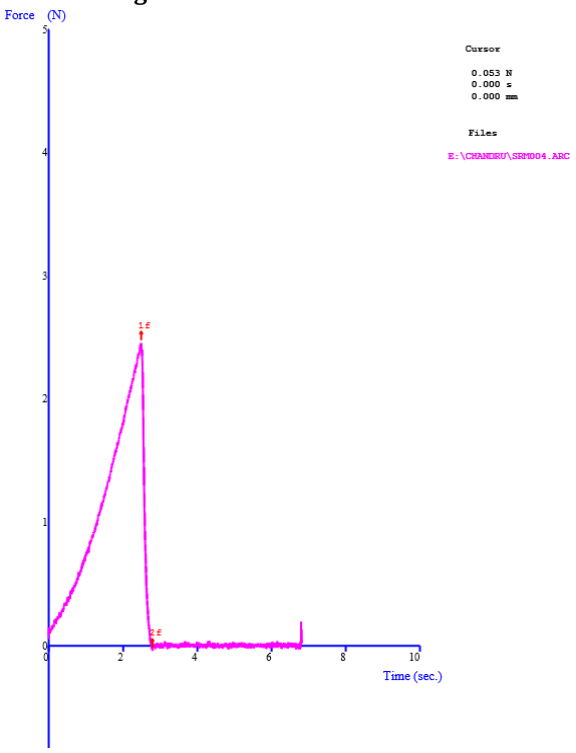

Fig.3.2. CitricacidControl

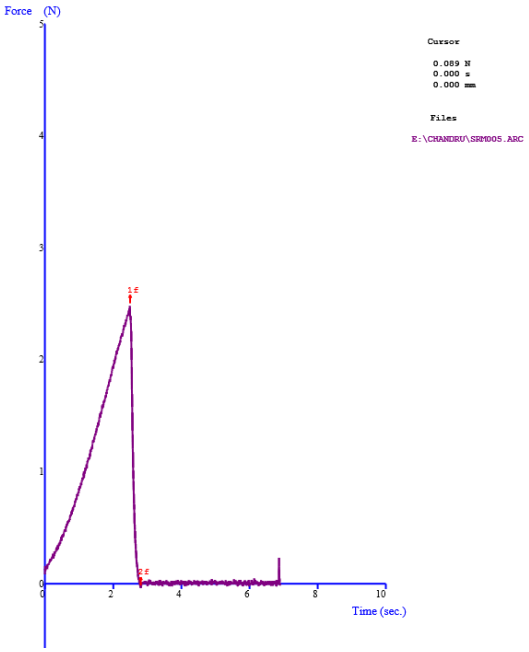

Fig.3.3. Sample1

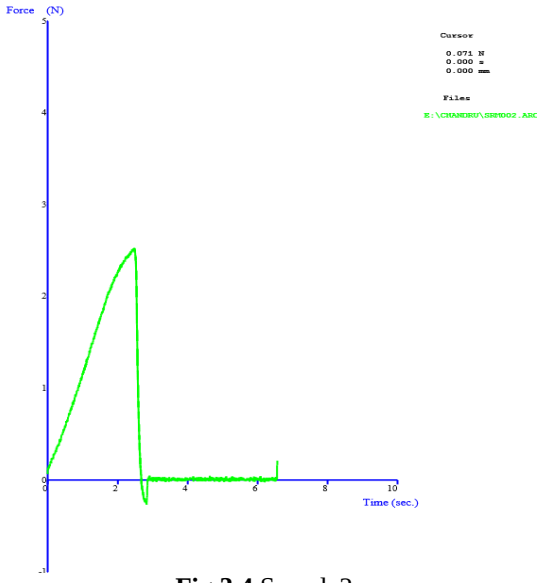

Fig.3.4. Sample2

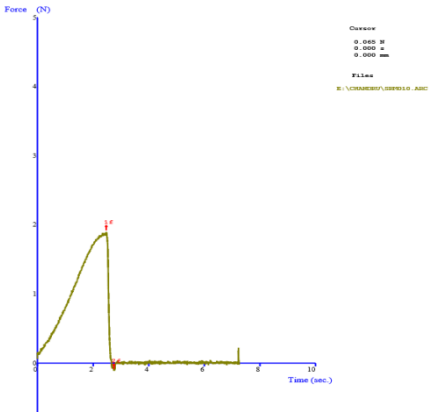

Fig.3.5. Sample3

Discussion:Comparingthesensoryandtexturalanalysisofthedifferentproportions Sample2hasparameterswhichareequivalenttothecontrolpaneersample.HenceSample2willbecarriedforfurthertrials.

3.1.3.ComparisonofSensoryAnalysis ofAscorbicAcidVariables

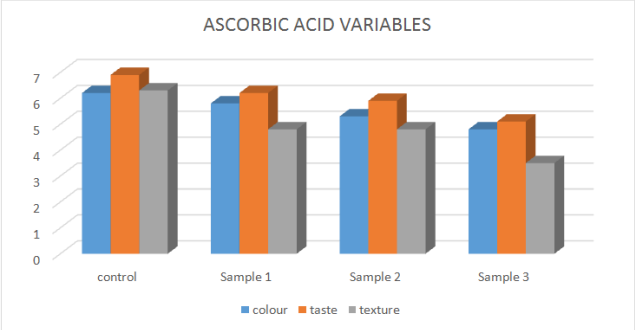

Fig3.6. Sensoryanalysisoftheproportionscoagulatedwith2%AscorbicAcid

3.1.4.TextureAnalysis ofAscorbicAcid Coagulated Flax Seed Milk Paneer Variables

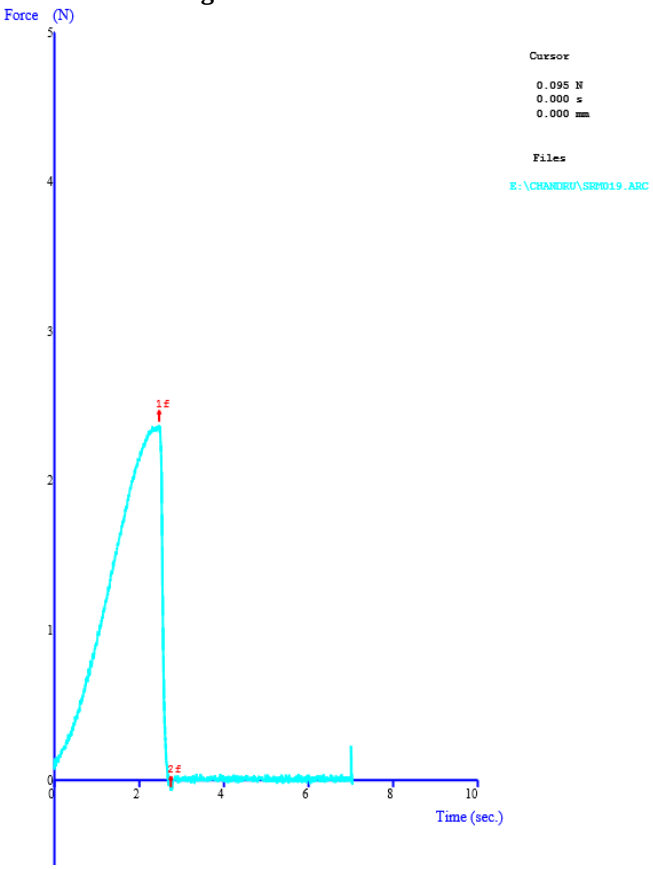

Fig. 3.7. AscorbicAcidControl

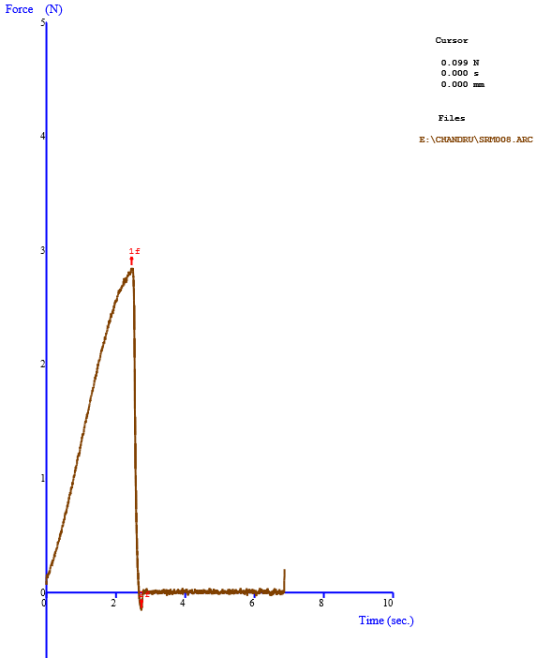

Fig.3.8. Sample1

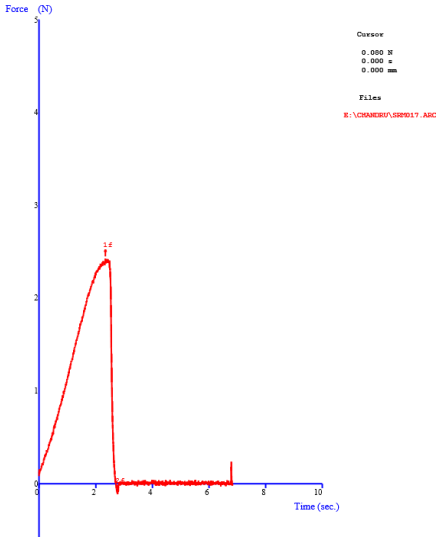

Fig.3.9. Sample2

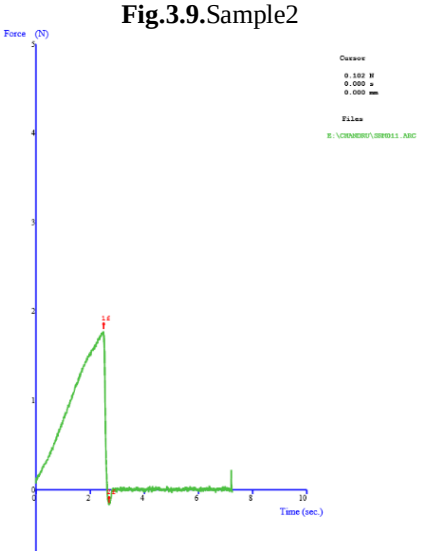

Fig.3.10. Sample3

Discussion:Itwasobservedthattherewasconsiderabledifferencebetweenthethreesamplesandthecontrolsampleinthes ensoryanalysisduetopoorappearanceandlackofpropertexture.Textureanalysisshowswidevariationintermsoffirmne ssoftheproduct.

3.1.5.ComparisonofSensoryAnalysis ofTartaricAcidVariables

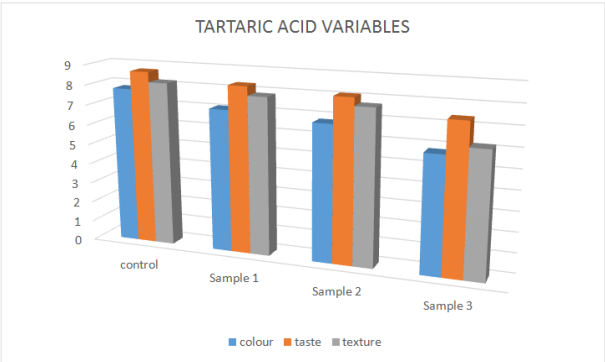

Fig.3.11. Sensoryanalysisoftheproportionscoagulatedwith4%TartaricAcid

3.1.6.TextureAnalysis ofTartaricAcid Coagulated Flax Seed Milk Paneer Variables

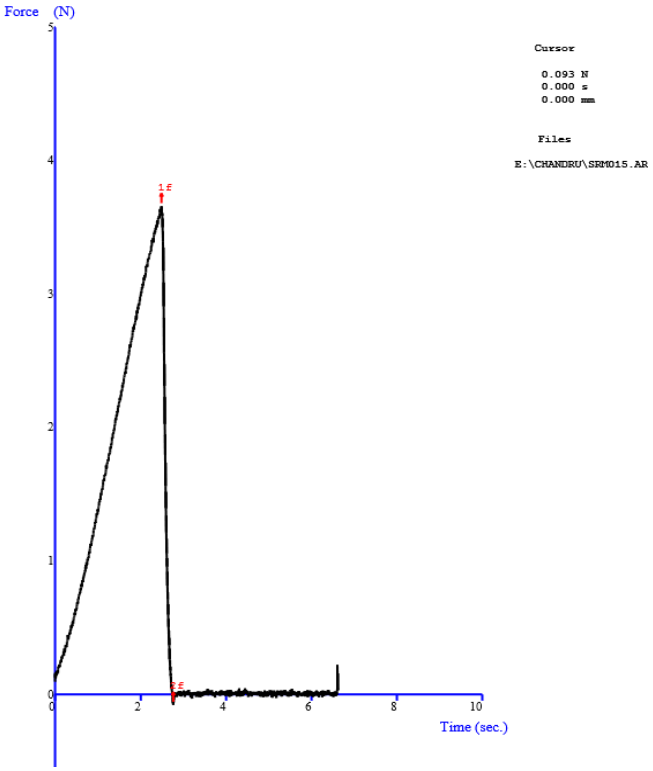

Fig. 3.12. TartaricAcidControl

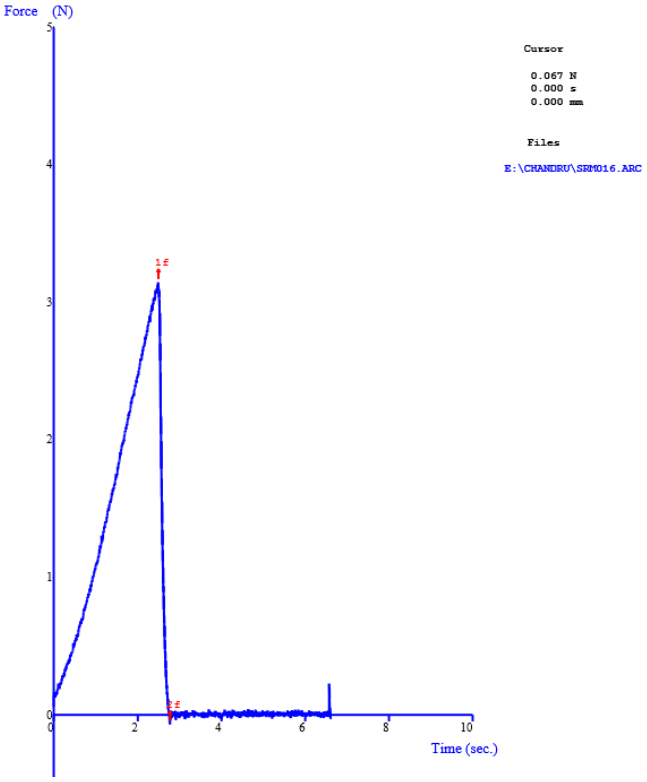

Fig. 3.13. Sample1

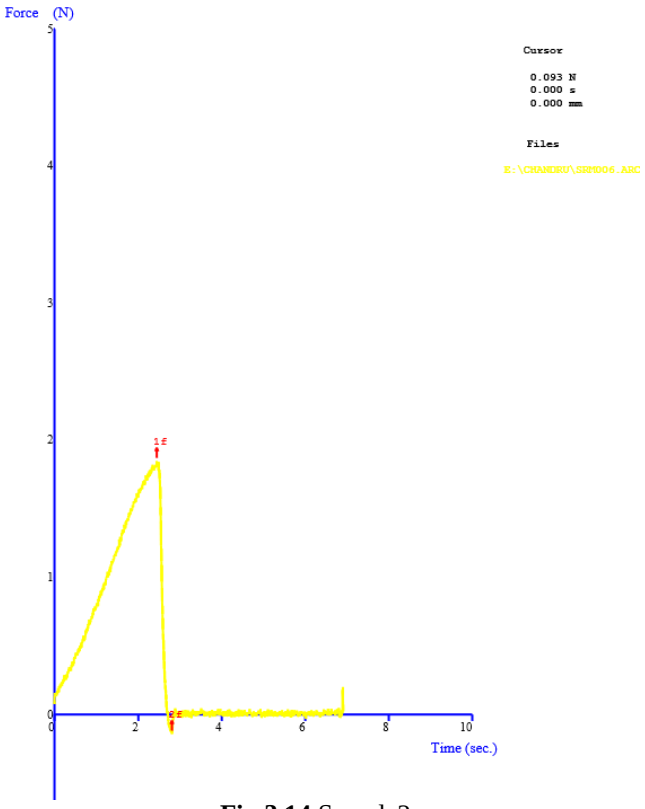

Fig.3.14. Sample2

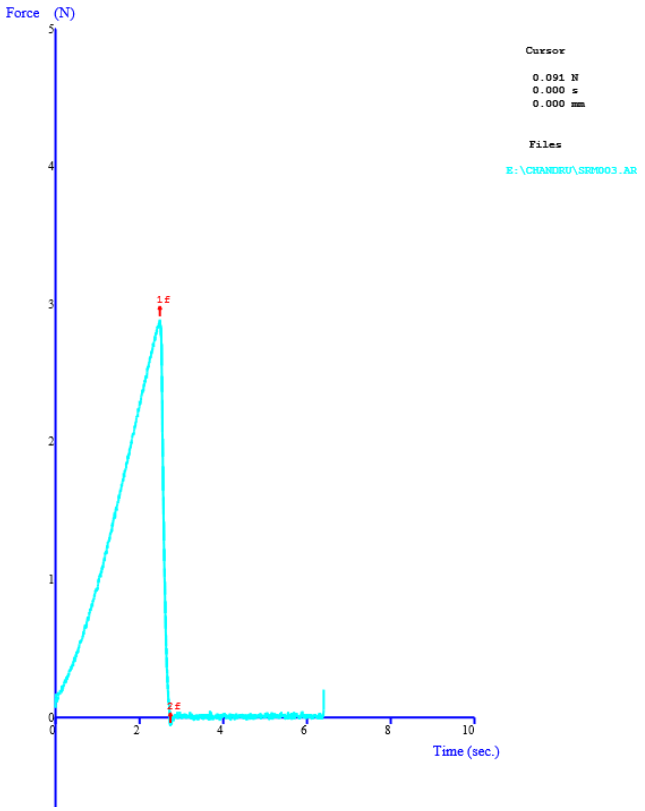

Fig.3.15. Sample3

Discussion: Oncomparingtheresultstexturalanalysisitisevidentthatsamplescoagulatedwithtartaricacidwerehardand hencenotpreferredinthesensoryanalysisbythepanelmembers.

Inference: OncomparingthesensoryanalysisvaluesinFigures3.1,3.5,3.10itcanbeconcludedthatthemostpreferredsa mplewasCitricacidcoagulatedSample2.TextureanalysisreportofCitricAcidcoagulatedSample2alsoshowedthatitha

sfirmnessof2.5Nwhichshowsverynegligiblevariationwhencomparedwiththecontrolsample.HenceSample2wasselectedandcarriedoutforapplicationofhurdleTechnology.

3.2.Effectof3%NaClonFlaxSeed MilkPaneer

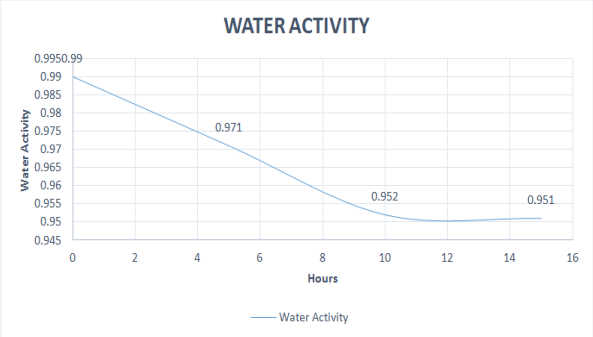

Fig.3.16. ChangesinwaterActivityduetotheeffectofdiffusionof3%NaCl

Discussion: ThepreparedFlaxseedmilkpaneerwassoakedin3%NaClSolutionandkeptat5°Cfor10hoursdiffusion.NaClisagoodhumectantanditbindstothefreewatermoleculesandtherebybringsaboutareductioninthewateractivityfrom0.99to0.951at28.5ºC.Redcutioninwateractivityisbelievedtoinhibitthegrowthofspoilagemicroorganismsandthereby aidinshelflifeextensionoftheproduct.HigherconcentrationsofNaClmayreducethewateractivitytoconsiderablelevels butitmayimpartasaltyflavourtotheproductandwasrejectedinsensoryanalysisandhence3%isconsideredtheoptimumconcentration(Thippeswamyetal2011)

3.3.Effectof0.1%Citric AcidonFlax Seed Milk Paneer

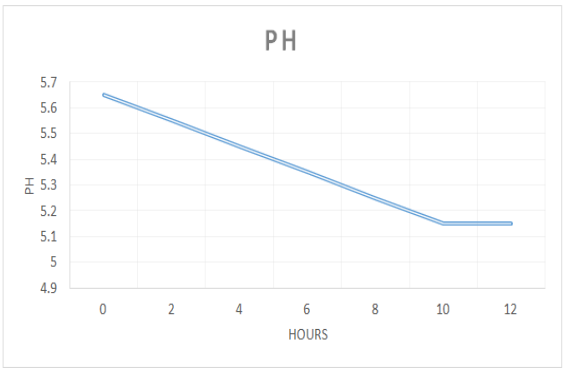

Fig.3.17. ChangesinpHduetotheeffectofdiffusionof0.1%CA

Discussion:pHisfoundtoreducefrom5.65to5.1whenpaneerwasdiffusedin0.1%CitricAcidsolutionat5°Cfor10hoursdiffusion.AtthislevelCitricAciddidnotimpartsouracidictasteandwaswithinacceptablelimits.(JayarajRaoandPatil1999).ReductioninpHisalsofoundtoinhibitmicrobialgrowth.
Thesamplesthuspreparedfromapplicationofhurdletechnologywerestoredupto20daysatrefrigeratedconditions.Microbialanalysiswasdoneforthesampleatthe20thday.

3.4.ComparisonofSensory Analysis oftheProduct atthe1stand20thDay

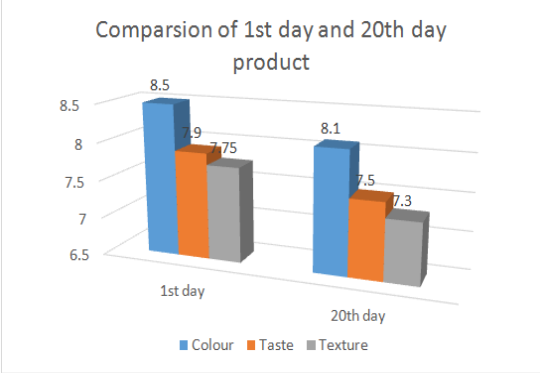

Fig.3.18. Sensoryanalysison1stand20thday

3.5.ComparisonofTexture Analysis ofthe Product atthe1st and20th Day

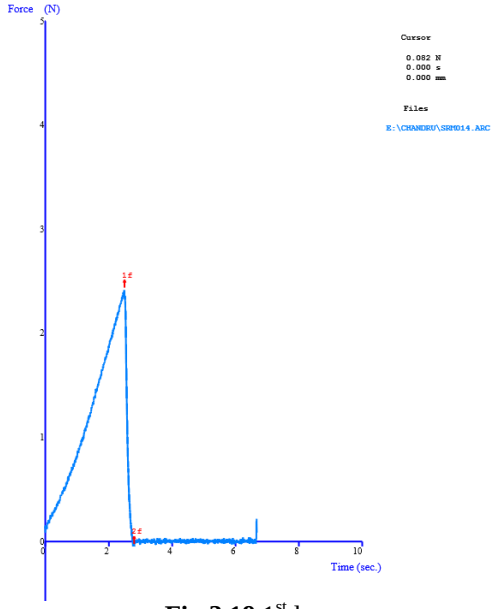

Fig.3.19.1st day

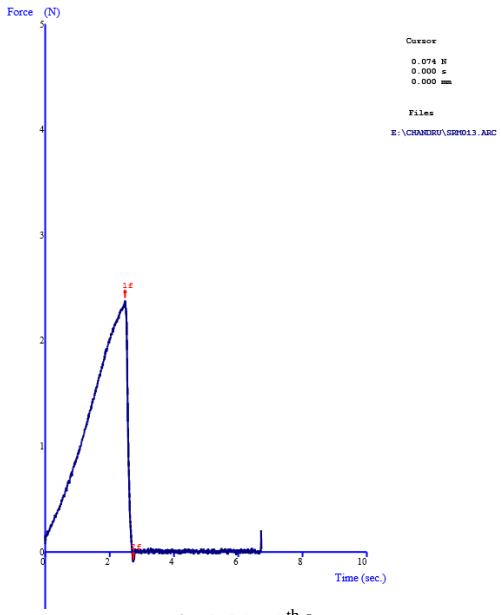

Fig.3.20.20th day

Discussion:Colourandappearancescoresoftheflaxseedmilkpaneeratthe20thdaywerelowercomparedtotheproductat 1stdayduetoturningofcolourofpaneertodullwhiteprobablyduetothescatteringoflightbythemoisturedropletsonthesur face.Thoughthescoresreducedthecolourandappearancewaswithinacceptablelevels.DiffusionofNaClincreasespalat abilityuptocertainlevelsbutduetothesaltyflavourthescoresslightlydecreasedbutmaynotbeobjectionablebecausethep roductwillbeusedinotherrecipescausingdilutionofsaltcontent.Thebodyandtexturescoresof NaCldiffusedpaneerdecr easedpossiblyduetothesofteninganddissolvingeffectofsaltontheproteinsinpaneer.Comparingthetextureanalysisgra phsFig:4.18&4.19aslightdecreaseinfirmnessisobservedonstorageupto20days.

Fig.3.21. FinalProduct

3.6 Physiso chemical and rheological Analysis:

Table3.2. Physico-chemicalandrheologicalcharacteristicsofflaxseedmilkpaneerper100g

Componentorcharacteristic	Content	Sensorycharacteristics
TotalCarbohydrate	28.5g	Color:Creamywhite
Fat	35.97g	Appearance:
Protein	16.4g	rubberysurface
Moisture	56.54%	Body:
pH	5.1	Uniformandsoft
Ash	1.15g	Texture:
Yieldfrom1litre	536g	Solidandslightlychewy
Firmness	2412N	Flavor:
Springiness	36.11	Milky

3.6.MicrobialAnalysis

Fig.3.22.Y&MgrowthonPDAMedium

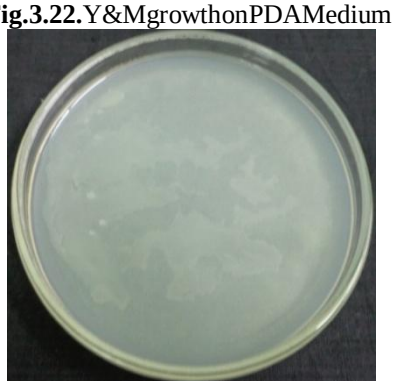

Fig.3.23.TPConNAmedia

Discussion:Inthetotalplatecountofthepaneersample,thebacterialcountwasshownas8×103cfu/gram.Surprisingly,singlecolonymorphologywasseeninthepaneersample.Nofungalspecieswasobservedinthepaneersample.

IV. Summary and Conclusion

Paneerisanindigenousdairyproduct.Itisanunaged,acid-set,non-meltingfarmercheeseorcurdcheesemadebycurdlingheatedmilkwithlemonjuice,vinegarorotherfoodacid,followedbydrainingthecurdsinmuslinorcheeseclothandthewheyispressedoutbyapplyingpressure.Theresultingpaneerisdippe

dinchilledwaterfor2–3hourstogiveitagoodtextureandappearance.Itrepresentsoneofthesoftvarietiesofcheese.

Omega3fattyacidsisnotavailabletothevegetarianpopulationbynaturalintakebutonlythroughsupplementsthereforethisprojectaimsatincorporatingFlaxseedtherichestnonanimalsourceofomega3fattyacidsinpaneerwhichservesasadelicacyinthevegetariancuisine.

Inthisstudy,flaxseedmilkpaneerwasprepared.Themethodsofpreparationandtheparameterswereoptimized.Theproportionofmixedmilkandflaxseedmilkthatgavebetterresultswas800mland200mlrespectively.Thisproportioncoagulatedwith2%citricacidwasselectedbecauseofitshighsensoryscoresandtexturalcharacteristics.Thehurdlesappliedforextendingshelflifewerereducedp$H$,reducedwateractivityanduseofpreservative.Thiswasachievedbydiffusionoftheproductin0.1%citricAcid,3%NaClsolutionand0.1%Potassiumsorbate.Thewateractivityreducedfrom0.99to0.95at28.5°CandpHvaluesweredecreasedto5.1from5.6.Theproductwaspackedinpolyethenebags,sealedandstoredfor20daysinrefrigeratedconditionsatatemperatureof5°C.TheSamplesonthe20thdayweresubjectedtosensory,texturalandmicrobialanalysisandresultswereacceptable.Slightlydecreasedsensoryvaluesandnegligibledifferenceintexturalpropertieswereobserved.Bacterialgrowthwithinthepermissibleloadof8×10^{3}cfu/gramwaspresent.NoYeastandmouldgrowthwasobserved.

Thisproductwasstandardisedandcanbeconcludedthat80:20ratioofmilk:flaxmilkcoagulatedbyusing2%Citricacidwasthebestproportionforcommercialmanufactureofflaxseedmilkpaneerandits shelflifecanbeextendedupto20daysbyuseofhurdletechnology.

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