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Formulation and Preparation of Fortified Paneer

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Abstract: ***This study was done to develop a low fat fortified paneer by using different types of milks viz., whole, standardized, toned and skim milks. One sample product was prepared from each milk type among the four different types of milk and evaluation was done based on hedonic scale rating. For low fat fortified paneer preparation toned, skim milks were optimised into a raw milk base to which coagulant was added. Citric acid (2%), Glucono Delta Lactose(GDL- 0.0035%) were added at 90c to the raw milk base. Citric acid facilitate the optimum coagulation of casein micelle. GDL aids in forming softer texture which also compensates the fat losses in whey. Milk is fortified with vitamin D to enhance nutritional property.The objective is to prepare a low fat fortified paneer . The organoleptic properties were analysed by sensory testing on daily basis for evaluation of shelf life for about 10 days. Upto sixth day, the overall acceptability in all parameters like appearance, texture/body, flavour is fairly satisfactory whereas from the seventh day a slight declination was observed due to the progressive degradation of the sample. Eventually, the overall acceptability for the final day was not too negligible on hedonic scale rating. Hence, toned milk was optimized and is proximately considered for the preparation of low fat fortified paneer when compared relatively with whole, standardized and skim milks.***

Keywords: Low-fat paneer, Fortification, Coagulation, Acidulate, Hedonic scale

I. INTRODUCTION

Paneer is a precipitate of milk which is oil in water emulsion. It is nutritious,whole some indigenous product among dairy products,has prominent place among traditional milk products to carry market potential. These products have high quality proteins, fat, minerals,vitamins. It is used as base material for preparing a large number of culinary dishes and is popular food product in household level as well as used in organized food chains. It is an excellent match of non-vegetarian food. The good quality Paneer is marble white appearance, has slight spongy body,close-knit texture and possesssweet-acidic-nutty flavour. It contains approximately 53-55% moisture, 23-25% fat, 17-18% proteins, 2-2.5% lactose, 1.5-2.0% minerals and retains about 90% fat & proteins, 50% minerals & 10% lactose of original milk.

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The good quality Paneer could be made with low cost by reducing the fat content to 3.0 and 3.5 percent as against the 6.0 percent milk fat Researchers and Medical Board have considered milk fat as a possible risk factor especially for Coronary Heart Diseases. (**George prince, Prasad** *et al*. **2007**). (**Kanawjia & Singh**, **1996**). **(Rao** *et al*, **1992)**. **Patel (1991) (Choksy 2006**).**GorgileJanakrajPrabhakar, (2016).**
The conventional paneer is rich in fat which pushes the prices of Paneer but also make unsuitable to consumers conscious of high fat diet. The present research work was conducted to optimize the fat content of low fat paneer from toned milk and to find out the nutritive value as well the sensory evaluation . (**Kanawjia 2001**), **Raga MadhuriReddam,**

II. MATERIALS AND METHODS

A. MATERIALS

Skim milk, Toned milk, Standard milk, Whole milk, all pasteurised having 1.5% fat and 9% SNF, 3% fat and 8.5% SNF, 4.5% fat and 8.5% SNF, 6% fat and 9% SNF respectively. The whole milk is procured from the milk collection centre in the village and the remaining milk types are taken from the plant itself. Coagulants used are food grade citric acid and Glucono delta lactone (GDL) taken from the Dairy's quality lab. Hydrochloric acid (37%), Sulphuric acid (98%) and Sodium Hydroxide solution (0.1N NaoH).

B. METHODS

Preparation of Paneer

The raw milk procured from the local milk collection centre by the dairy plant is used. The fat content ranges from 6.0 to 0.05 %. One litre of toned milk was optimized with skim milk and used as raw milk base. Raw chilled milk is kept in room for obtaining room temperature and the significant step was that the temperatures of both acidulate and milk should be equivalent. Milk fortified with vitamin D is mixed well, heated to 85°C for 10 min and followed by cooling to 70°C. Milk was then coagulated to temperature with 0.0035% GDL (3.5g of GDL was dissolved in 1litre) and 2% Citric acid reagent was added slowly and continuously stirred until the milk and whey gets separated out , allow curd particles to get settled. Then whey is drained and curd is pressed using a hydraulic press into blocks applying 4-5kg of pressure for 10-15 minutes. Then the paneer blocks are cut into suitable sizes and placed in cool water of temperature 4-6˚C for 2 hours. They are packed in polythene pouches and stored in refrigerator under -10˚C.

C. Qualitative tests for milk

Formalin Test

To 10ml of milk, 5ml of 90-92% H_2SO_4 is added but not mixed. If blue or purple colour is seen, then it confirms the presence of formalin but if it gives brown or black colour the test is negative for formalin**.**

AOAC (1993).

Hydrogen peroxide Test

To 5ml of milk, 5 drops of 2% paraphenylene diamine solution is added. 2g of P-phenylene diamine powder in 100ml forms 2% of the solution. If the colour of milk turns blue colour then the presence of H_2O_2. If the colour is still white or grey, the test is negative. **AOAC (1990).**

Determination of fat by Gerber method

To a 5g of crushed paneer sample, 10ml of Conc. Sulphuric acid and 1ml of Iso-amyl alcohol were added in butyrometer and then it is closed using stopper and shaken vigorously till the contents as mixed well. It is then placed in water bath at 65˚C ± 20 for an hour. It was shaken periodically until the solution of paneer is complete. It was centrifuged at 1200rpm for 5 minutes. The fat percentage was measured by adjusting the scale of butyrometer. The percentage of fat present is taken directly. **AOAC (1993).**

Estimation of SNF

To 100g of curd, 10ml of 25% of ammonium solution and mixed well. After 10-15 minute 3s the procedure carried out is similar as for raw milk fat testing. The SNF is calculated directly using a formula knowing the fat content**. AOAC (1990).**

$$\text{SNF} = \frac{CLR}{4} + (0.2 \times \text{fat}) + 0.36$$

Where, CLR is corrected lactometer reading.

Titrable acidity

To 2g of crushed paneer sample, 5ml of distilled water was added and made into a paste and then 15ml of water is added to make it up to 20ml.10ml of 0.1N NaOH,add 2-4 drops of phenolphthalein indicator,titrate against 0.1N HCl till the pink colour disappears and then stirr vigorously. Using the below mentioned formula the titrable acidity as lactic acid equivalent. **AOAC (1984).**

$$\% \text{ Titrable acidity} = \frac{10 - V \times N}{wt\ of\ sample} \times 0.9$$

Where, V = volume of 0.1N HCl required for titration and 0.9 is a constant.

Determination of Moisture

5g of crushed paneer was taken into petridish and dried in hot air oven at 102˚C until constant weight was observed. The difference in initial and final weight gives the amount of moisture present in the paneer sample. (*Anal. Chem.*, **1951)**

The formula used is,

$$\% \text{ Moisture} = \frac{W1 - W2}{W1 - W} \times 100$$

Where, W_1 is weight of sample before drying.
W_2 is weight of sample after drying.
W is weight of empty petri-dish.

Determination of Protein by Pynes method

At first, the blank was titrated, a mixture of 2% formalin or formaldehyde, 10ml of distilled water, 5 drops of phenolphthalein indicator. 0.1N NaOH was the titrant used. The titration is carried until the end point, pink colour is seen. The formalin is neutralized due to the mixing ratio 1:5 i.e. 2ml of formalin in 10ml of distilled water and then titrated against the titrant. The burette readings of both titrations were added and named as B.R. For the %protein in milk sample, 0.4N potassium oxalate prepared by dissolving 37.7g of the salt in 100ml distilled water. Now, to 10ml of milk, add 5 drops of phenolphthalein indicator and 0.4ml potassium oxalate solution and then mixed thoroughly for 2-4 minutes, titrate against 0.1N NaOH until the end point, pink colour is seen. **Moir (1931). Analyst, 56, 147. Pyne (1932) Biochem. J. 26, 1006**

The protein content of milk is calculated by

$$\% \text{ Protein} = BR \times 1.7$$

Where, BR is total burette readings ($BR_1 + BR_2$ = total BR) And the integer, 1.7 is the Pynes constant.

Determination of Total ash

3g of sample was taken in silica crucibles which is previously dried in hot air oven and weighed. The crucible with ample was weighed and noted. It is then placed on flame until the sample is charred. After charring the crucibles are kept in muffle furnace at 550˚C ± 10 until the white ash colour appears and then they are cooled and left in the desiccator**. AOAC (1995) Official Methods of Analysis. 16th edn.**

By using the below given formula, the amount of ash was determined.

$$\% \ Total\ Ash = \frac{W1 - W2}{W1 - W} \times 100$$

Where, W_1 is weight of the sample before ashing.

W_2 is weight of the sample after ashing.

W is weight of the empty crucible.

Determination of Acid Insoluble Ash

To make ash 25ml of dilute HCL was added and covered with watch glass and kept in water bath for 10 minutes and then it was filtered using Whatman filter paper of pore size 44. The filter was washed until the washings are no longer acidic which were identified using indicator. The material transferred into the same crucible and kept in hot air oven at 100˚C ± 2 for 3 hours and then in muffle furnace at 550˚C ±10 for 1 hour. Crucible was cooled in desiccator and weighed. **AOAC (1995) Official Methods of Analysis. Meth no 955.03**

The amount of acid insoluble ash was calculated as

$$\% \text{ Acid insoluble ash} = \frac{W1 - W2}{W1 - W} \times 100$$

Where, W_1 = weight of sample before ashing.

W_2 = weight of the crucible with acid insoluble ash.

W = weight of the empty crucible.

Salt Insolubility Test

To 50g of sample, 200ml of water was added and then the filter paper is taken and noted down its initial weight (W_1) and then filter the mixture and dried in oven at 102˚C for 1 hour and cooled in desiccators for 5 minutes and its weight (W_2) is taken. **AOAC (2011)**

The insolubility is calculated by using the formula,

Gain of weight = $W_2 - W_1$

,

$$\text{Insolubility} = \frac{gain\ of\ weight}{sample\ weight} \times 100$$

III. RESULTS AND DISCUSSION

A. Proximate Analysis

The composition of different milk types were analysed and the results obtained are displayed in the below table

Table.1 Proximate analysis data of paneer prepared using different types of milk

Parameters	Whole Milk (%)	Standardised Milk (%)	Toned Milk (%)	Skim Milk (%)
% yield	18.02	16.1	15	9.12
Moisture	52. 08	53.58	56	62.5
Fat content	25.37	19.98	15.96	5.4
Protein	16.81	17.18	17.69	30.02
Ash	0. 70	0.82	1.22	1.47
T.A	0.185	0.146	0.16	0.182

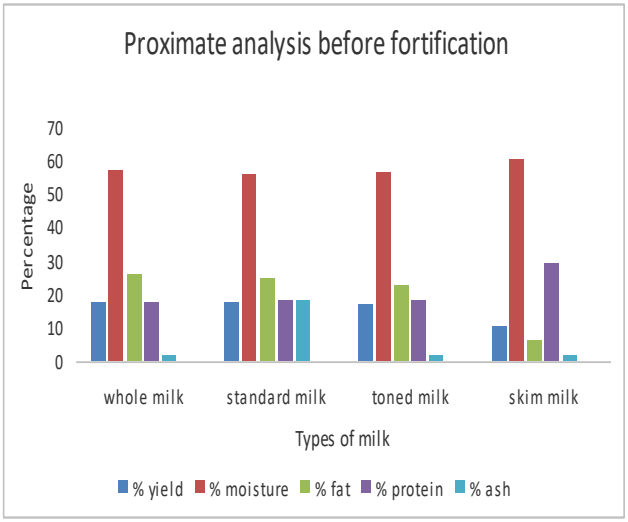

Fig.1. Proximate analysis of paneer before fortification

From above graphical representation, it is clearly stated that whole milk is having 18.02% yield, whereas standardized milk, toned and skim milks are having 16.1%, 15.01%, 9.12% respectively. Similarly fat content of whole, standardized, toned, skim milks are 25.37%, 19.98%, 15.96%, 5.4% respectively. On a comparative account, toned milk having 3% fat is suitable to the production of low fat paneer. As skim milk has lesser fat comparatively paneer prepared from toned milk shows acceptable textural properties as the skim milk paneer show hard, rubbery, coarse granules of the product which is undesirable. Moisture range in all the 4 types of milks is compared and has optimum total solids suitable for low fat paneer production. Even though the skim milk has higher moisture range than toned milk paneer prepared from it will result in loose, hard body texture which is undesirable. As the protein value signifies that toned milk has the higher protein content, though skim milk exceeds the range product prepared from it is not acceptable in any form. Therefore comparatively toned milk is an absolute fulfilment of the desired parameters in production of low fat paneer. As the values for TA % are below the range of scale representation on graph. Hence, there were not plotted along with all the other parameters. TA % for whole, standardized, toned, skim milks are 0.185%, 0.146%, 0.16%, 0.182% respectively.

B. Quality tests on milk

Few tests were conducted to check the quality of milk types which were procured from the local market. The tests were to detect formalin and hydrogen peroxide which gave results as negative. Hence, the milk types used were of fine quality.

Table.II . Percentage SNF and Fat of milk types used to make paneer

Milk Type	SNF (%)	Fat (%)
Whole Milk	9	6
Standard Milk	8.5	4.5
Toned Milk	8.5	3
Skim Milk	9	0.6

Fig.2 SNF and Fat percentages of milk types used to make paneer

According to PFA (1955), milks having varied fat and SNF percent are represented above which on scaling the best type is opted for low fat paneer production with fat, SNF% (3.0% , 8.5%) i.e., toned milk rather to whole milk fat and SNF % (6.0% , 9.5%), standardized milk with the fat and SNF % (4.5% , 8.5%), skim milk with the fat and SNF % (9.0% , 0.6%) respectively.

C. Proximate analysis of fortified low fat paneer

The proximate analysis was carried out to check vitamin retention after fortification.

Table III Proximate analysis data for fortified low fat paneer

Parameters	Whole Milk (%)	Standardised Milk (%)	Toned Milk (%)	Skim Milk (%)
% yield	17.9	17.9	16.90	10.62
Moisture	57. 28	55.98	56.84	60.5
Fat content	25.97	24.8	22.62	5.92
Protein	17.81	18.04	17.98	29.02
Ash	1.70	1.32	1.4	1.63
T.A	0.18	0.151	0.174	0.181

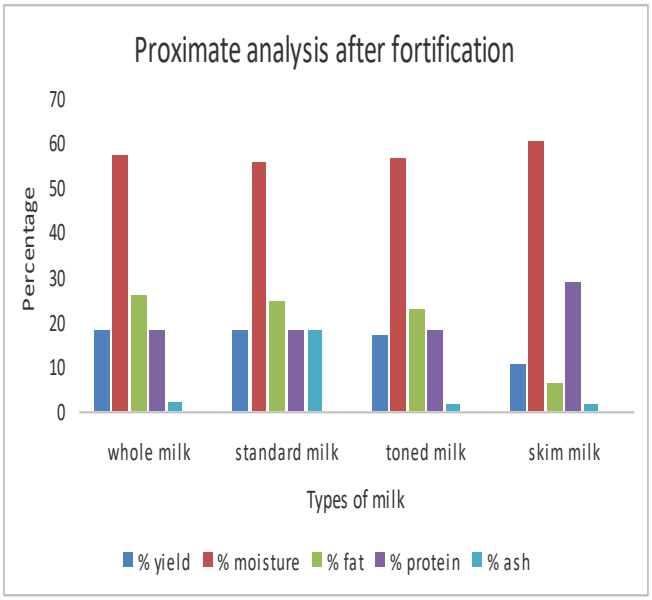

Fig.3 Proximate analysis of paneer after fortification

On relative comparison of whole milk parameters with all the types of milks like standardized, toned, skim. Toned milk has a significance relative acceptability like that of whole milk paneer. With the comparisons made between the parameters of moisture, fat, protein, yield after fortification of paneer. Toned milk have shown a proportional increase in yield, moisture, fat and protein with a negligible variation to that of whole milk paneer which is desirable for the manufactory of low fat paneer. After fortification, the protein content in toned milk has increased from 17.09% to 18.02%. Whereas in skim milk it has decreased. As a production of low fat paneer is concerned, toned milk has the best fulfilment in fortified low fat paneer and the acceptability range is comparatively similar to that of paneer made from full cream milk. After proximate analysis of data obtained from fortified low fat paneer, the TA % values are below 0.5% range. Hence, they can´t be plotted on graphical representation. TA % values after fortification obtained with whole, standardized, toned, skim milks were 0.18%, 0.151%, 0.174%, 0.181% respectively

D. Comparative graphs of proximate analysis of paneer before and after fortification

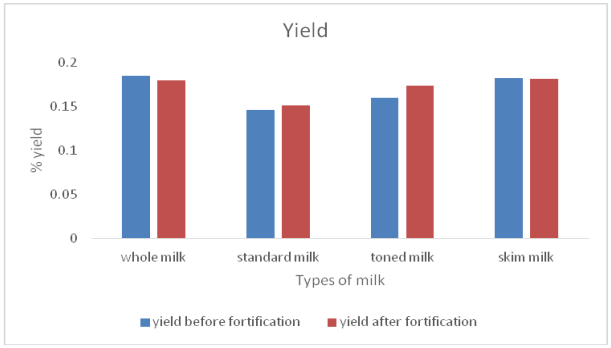

Fig.4 comparative graph for yield

On comparing different types of milks, toned milk have shown a proportional increase in its yield on fortification which thereby increases the profits. Due to incorporation of GDL coagulant along with citric acid no fat losses were observed in drained whey which thereby increases the yield of paneer to a significant level when compared with whole milk paneer.

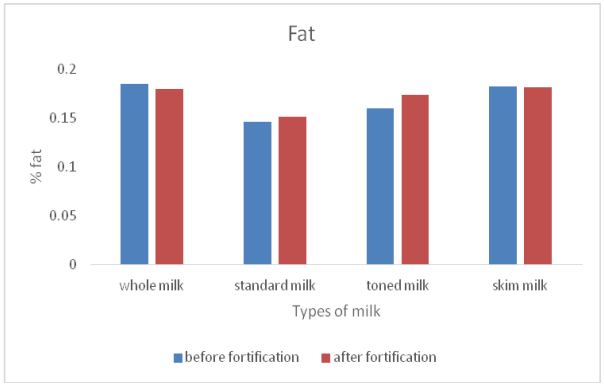

Fig.5 comparative graph for fat

After statistical analysis of data from different types of milks, toned milk have shown a significant increase in its total solids which facilitates low fat paneer production. Due to the raise of total solids in toned milk after fortification, it was easier for the separation of precipitated product from the straw coloured whey.

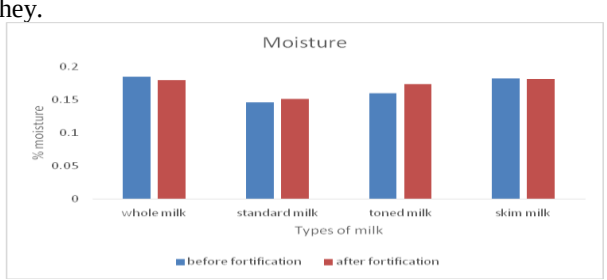

Fig.6 comparative graph for moisture

Even though the increase in level of fat in skim milk after fortification was equivalently similar to that of before fortification when compared with toned milk whose fat level has been increased after fortification which facilitates soft, creamy texture to low fat paneer.

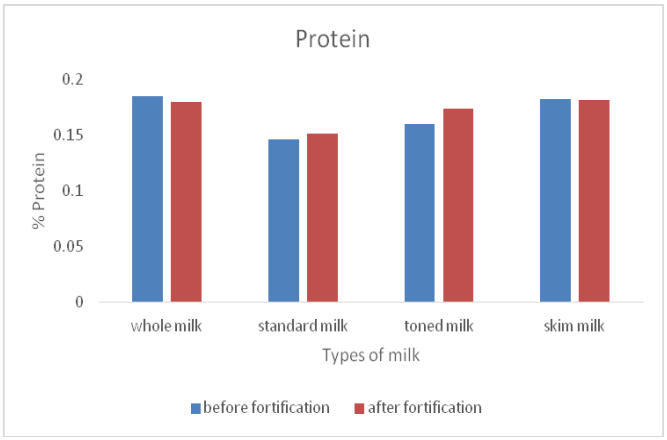

Fig.7 comparative graph for protein

Comparatively toned milk has an increase in its protein content after fortification which compensates the nutrition deficiency of protein in humans.In addition to that if toned milk is incorporated with soy protein isolates it can be a absolute fat replacer in terms of high diet persons.

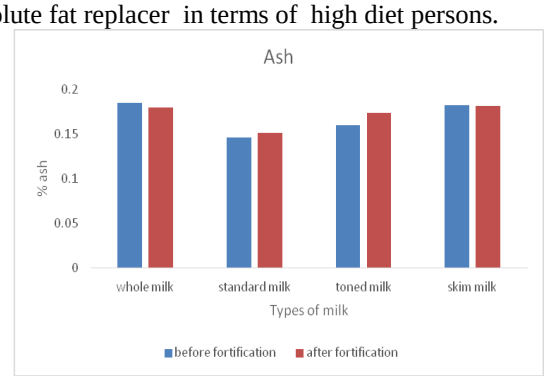

Fig.8 comparative graph for ash

In different types of milks, ash content signifies mineral value. Toned milk mineral value have shown an increase after fortification which is a supplier of nutritional diet. Hence it is inferred that toned milk was opted for fortified low fat paneer when compared with
Other types of milks.

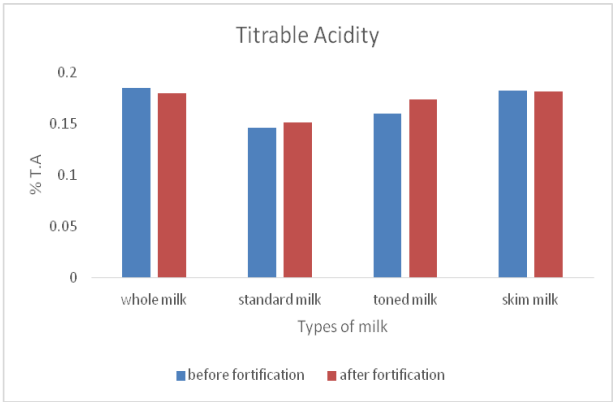

Fig.9 Comparative graph for Titrable Acidity

On evaluation of organoleptic properties, it is evident that the TA % in toned milk has been increased progressively during its shelf life study. Primarily TA % determines the deterioration of the product with extended shelf life where in toned milk after fortification the increase in level of TA % is not too noticeably degraded in terms of flavor and texture.

E. Shelf-life study

Right after the preparation of pander from different types of milk it was kept under refrigeration at temperature 3 to 4˚C. Sensory evaluation was carried out with 4 member panel for 10 days to keep a check on its shelf-life. 'A' is pander from whole milk, 'B' is pander from standardized milk, 'C' is pander from toned milk, 'D' is from skim milk. The sensory evaluation was carried out for 10 days.

After the examining the organoleptic evaluation of the paneer made from different types of milk for 10 days, I conclude on the basis of data obtained, the paneer made from toned milk which is the low fat and fortified paneer is stable for 10 days under refrigeration. The paneer made from whole milk ranged from 8 to 7, paneer made from standard milk ranged from 8 to 7, paneer made from toned milk ranged from 8 to 6.5 and paneer made from skim milk ranged from 7.5 to 6. Finally, the low fat fortified paneer can be confirmed to be a protein rich, lower fat containing made from toned milk is feasible to consume.

F. Sensory Graphs for Low Fat Paneer

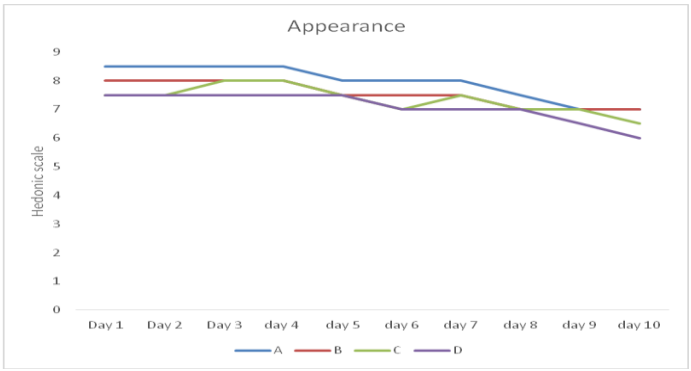

Fig.10 Appearance parameter of paneer made from different milk types

During, the first day of shelf life study the appearance parameter is fulfilled and acceptable in all the four types fairly ranging from 8-7.5 on hedonic scale.Whole milk paneer when compared with low fat toned milk has shown almost similar appearance. As the days got progressed on the fourth day there is a slight decrease in appearance factor. Whereas from fourth day to the last day the variation in appearance is persistent and on the last day the appearance parameter has decreased to a fairer level which is still acceptable.

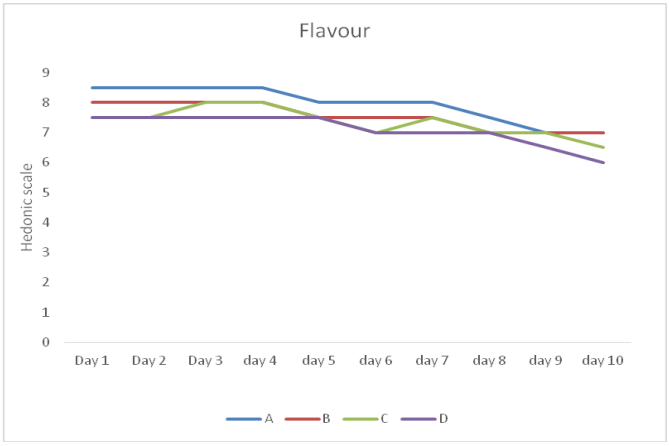

Fig.11 Flavour parameter of paneer from different types of milk

In flavour, there is a variation in whole milk paneer vs. toned milk low fat paneer. As the first five days the variation is negligible, there after from the sixth day decreased by a point on the scale readings, due to a slight degradation of the functional compounds. Whereas, on the final day the flavor is satisfactorily acceptable as to that of standardized milk paneer.

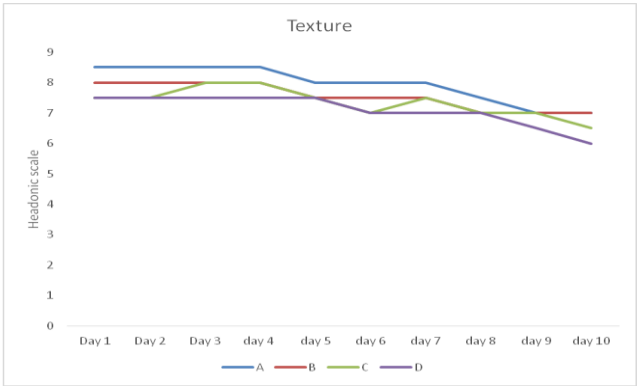

Fig.12 Texture parameter of paneer from different types of milk

Comparatively the textural properties of the paneer prepared from whole milk has fulfilled the requirements absolutely whereas the toned milk paneer has a slight declination as the days are progressed, the reading has declined from 7.5 - 6 which can be optimised by adding hydrocolloids if required. The decline is due to low fat content in toned milk in comparision with whole milk paneer.

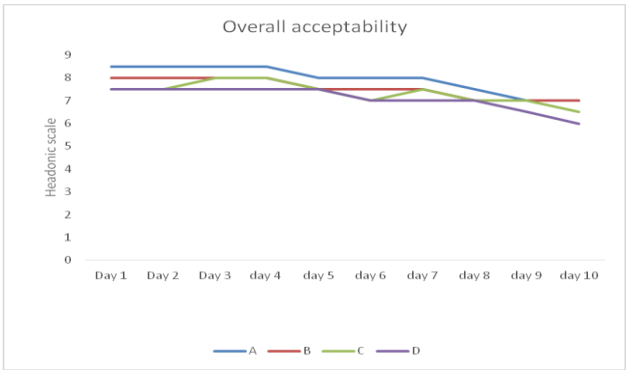

Fig.13 Overall acceptability parameter of paneer prepared from different types of milk

On an overall view, the acceptability of paneer made from different types of milk is statistically plotted on day wise scaling. Finally, it is concluded that the overall acceptability of low fat paneer prepared from toned milk has also similar acceptability range as that of whole milk sample which is an absolute satisfactory result on comparing all over the days in shelf life evaluation. On an average whole milk paneer has an acceptable range of 8.5 - 8 in all parameters whereas paneer from toned milk stood up with 7.5 - 8 acceptability range which has fairly fulfilled the requirements of low fat paneer production.

IV. CONCLUSION

The results of paneer prepared from toned milk has low fat compared to full cream milk (whole milk) paneer and the sensory property is nearly equal. Therefore, toned milk paneer is good for obese persons because of its low fat content. By the analysis the full cream milk paneer has 25.37% fat, toned milk paneer has 15.96% fat and skimmed milk paneer has 5.4% fat. But after conducting sensory, skim milk has poor acceptability compared to the other samples. Toned milk paneer and full cream milk paneer are having nearly equal acceptability. In full cream milk the fat percentage is high so toned milk paneer is suggestible for obese and people having cardiac diseases. So Paneer is significantly affected by different coagulant used, therefore the fat, moisture and yield content was significantly affected on the texture, taste and overall acceptability also. The textural properties of paneer varies with the level of fat, moisture, yield content as well as difference in coagulants. So from the present it can be concluded that among four samples using single coagulant for the preparation of Paneer by Raw milk mixture (toned milk and skim milk in 3:1ratio), 0.0035% GDL mixed with 2% citric acid in 1:1 ratio gives good results in providing best texture properties as well as chemical and organoleptic tests. It was observed that fat level of paneer contributed to its soft and spongy body and rich flavour. However, milk containing up to 3.0 per cent fat results fairly acceptable product. Though it lacked slight in richness of flavour, the product made from milk containing 1.5 percent fat was unacceptable and was criticized that it was hard, rubbery and chewy. Even after fortifying the low fat paneer with vitamins, there were no reports on change of appearance or other organoleptic properties. This indicates that the final product has the scope in the market as the fat content is low which is good for consumption by people who are on protein diet and for people who are vegetarians and also for people suffering from chronic heart diseases, vitamin deficiency diseases.

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