

DEVELOPMENT OF HERBAL AND SPICED PANEER

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Abstract - Paneer is one of the coagulated milk products containing high nutritional value components like energy, fat, vitamin, protein, minerals, etc. With the increasing consumption and consequent changes in taste preferences, there is an ample scope for developing new variety of paneer such as spiced and herbed impregnated. The objective of this study was to develop herbed and spiced paneer and to analyze the physiochemical properties of the developed paneer. Different coagulants, were used such as malic, lactic, citric and acetic acid. Three different varieties of dry leaves such as Indian borage (*Coleus aromaticus*), Oregano (*Origanum vulgare*) and Sage (*Salvia officinalis*) leaves were used for developing paneer. In this study physio-chemical, sensory, nutritional analysis and microbiological property of developed products was investigated. The effect of coagulation temperature, coagulation acid and concentration of acid on pH, acidity of whey and textural characteristics of paneer was investigated. The developed paneer had higher shelf life and nutritional value when compared with that of market samples.

Key words - Coagulated milk, flavored paneer, product characteristics, microbial analysis, shelf life study.

1. INTRODUCTION

Paneer is the best selling coagulated milk products in India. But shelf life and nutritional value of these milk products are very less when compared to other functional products. This is the major problem which affect the producers and consumers.

Paneer is an acid coagulated product obtained when standardized milk coagulated with the permitted acids at specified temperature, resultant coagulum is filtered and pressed to get the solid curd mass. Paneer has firm, close, cohesive and spongy body and smooth texture. *Paneer* represents one of the soft varieties of cheese family and is used in culinary dishes/snacks. About 5% of milk produced in India is converted into *paneer*. Paneer is mainly prepared from buffalo milk and used for large number of culinary dishes. According to FSSA act, 2011 Paneer product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic

acid, or citric acid. It shall not contain more than 70% moisture and milk fat content shall not be less than 50% of the dry matter. Milk solids may also be used in the preparation of this product. Low fat paneer shall contain not more than 70% moisture and not more than 15% milk fat on dry matter basis.

1.1 Types of plant leaves

1.1.1 Indian borage

Coleus aromaticus (Benth, Family: Lamiaceae), commonly known as Indian/country borage is an important aromatic herb of the family Lamiaceae. The leaves are mainly used for the treatment of stomach disorder, asthma, epilepsy and renal diseases. These are reported to have anti-oxidant and anti-microbial properties. The fresh or dried leaves are also used for culinary purposes in most of the countries for flavoring, seasoning and as condiment and spice for different food preparations.



Fig - 1: Indian borageleaves

1.1.2 Oregano

Origanum vulgare (also referred to as Spanish thyme and wild marjoram), a member of the plant family Lamiaceae (Labiatae). Medicinal uses for oregano date back to the ancient Greek and Roman empires where applications of the leaves were used to treat skin sores, to relieve aching muscles, and as an antiseptic. Oregano also has been used in traditional medicines for such ailments as asthma, cramping, diarrhea, and indigestion.

1.1.3 Sage leaves

Sage (*Salvia*) species have been used for centuries, worldwide as culinary herbs as well as traditional remedies for the treatment of many common health

complications and their symptoms. A number of sage family members especially *Salvia officinalis*(common sage) and their components have shown to be beneficial in protecting the body against oxidative stress, free radical damages, angiogenesis, inflammation, bacterial and virus infection, etc. Several studies suggest that sage might potentially provide novel natural treatments for the relief or cure of many serious and life-threatening diseases in addition to treating minor common illnesses such as depression, dementia, obesity, diabetes, lupus, autism, heart disease and cancer.

1.2 Coagulant acids

Different types of acids are used for coagulation of milk, Lactic acid, Acetic acid, Malic acid and citric acid. Depend on the acid used, paneer characteristics are varied. The paneer (also for Chhana) means the product precipitation with sour milk and coagulant acid. Different factors are affecting the quality of paneer, such as type of milk, type of coagulant use, coagulation temperature, pH of coagulation, Pressing time, Holding time, Yield of paneer, Microbial quality, Sensory analysis and packaging/ Shelf life.

In this study herbed and spiced coagulated milk products like paneer will be developed. Physio-chemical and microbiological properties of developed products was investigated and comparative study was done between developed products and market available products.

2 MATERIALS AND METHODS

2.1 Materials Required

- Plant leaves
- Coagulant Acids
- Milk
- Spices

2.2 Methodology

2.2.1 Paneer Development

Paneer is a coagulated milk product, that has a standard procedure for its production (Walstra, 1999). In this study, we are developing a paneer with incorporation of herbs and spices. The flow sheet for preparation of herbed and spiced paneer is given in the figure 2

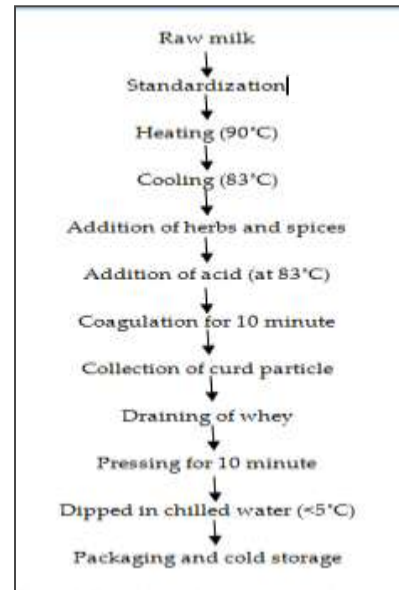


Fig- 2: Flow sheet for Paneer development

2.2.2 Hot air oven drying of Indian borage leaves

Fresh leaves was collected from local area and it was cleaned with fresh water. It was kept in hot air oven at 102°C for 9hours. The initial weight of leaf was 500g and the moisture content of leaf was checked for every one hour interval till constant reading was achieved (Suchismitaet *al.*, 2012). The hot air oven used for drying borage leaves is shown in the figure 3.2 and the dried leaves is given in the figure 3



Fig - 3: Dried Borage leaves

2.2.3 Oregano and Sage leaves collection

Dried Oregano and Sage leaves were collected from local herbal market and stored in closed dry bottles.



Fig - 4: Dried Oregano leaves



Fig - 5: Dried Sage leaves

2.2.4 Paneer Trial

For paneer development, raw cow milk collected from the industry was used. The milk quality was checked as per the standard procedure available in the industry. Raw milk was standardized to a fat level of 4.3% and Solid Not Fat (SNF) of 8.14% using fresh cow cream for achieving the required ratio of 1:1.85. Different coagulant acids were used for this paneer development such as citric acid, lactic acid, malic acid and acetic acid. Acids were varied based on the trial. The paneer characteristics are dependent on the coagulant used and the temperature of coagulation. The effect of coagulant concentration and type of coagulant on the paneer characteristics was studied to optimize the coagulant and its concentration.

2.2.5 Experimental Procedure

2.5 Litre of standardized cow milk was taken in a vessel and heated up to 90°C. Temperature was noted down using digital thermometer. After reaching the required temperature, it was cooled down to coagulation temperature. Different coagulation temperatures (75°C, 80°C, 83°C) were tried in the pre trials of paneer sample conducted in the lab. Herbs were added at this temperature and stirred slowly. Different coagulants (Acetic acid, lactic acid, citric acid and malic acid) with different concentration (1%, 1.5% and 2%) were used for the coagulation of milk sample. For this paneer trial 1L of acids were prepared and it was heated up to 83°C. Then the acid was poured into the milk and stirred slowly at this same temperature until it reaches a pH of 4.85. After desired the pH was attained, coagulated milk sample was held for 10min at 80°C. The whey was drained from paneer sample using muslin cloth and pressing of curd particles was done with 2.5kg/sq cm weight, and held for 10 min. After that, the paneer was kept in 4°C chilled water for 2hrs and measured the paneer weight using weighing balance. Then the paneer sample was packed in vacuum packaging machine. Same procedure was carried out for all paneer trials.

2.2.5.1 Paneer development using dried Indian borage leaves and spices

Dried Indian borage leaf and spices were used in this trial. 2.5g of dry leaf and required amount of spices were added to milk sample. The acid used for this trial was malic acid, lactic acid, citric acid and acetic acid. Same experimental procedure was followed in this trial.

2.2.5.2 Paneer development using dried Sage leaves and spices

Dried sage leaf and spices were used in this trial. 2.5g of dry leaf and required amount of spices was added to milk sample. Malic acid, citric acid, lactic acid and acetic acid were used for this sample trials. Same experimental procedure was followed in this trial.

2.2.5.3 Paneer development using dried Oregano leaves and spices

Dried oregano leaf and spices were used in this trial. 2.5g of dry leaf and required amount of spices were added to milk sample. Malic acid, lactic acid, citric acid and acetic acid were used for this sample trials. Same experimental procedure was followed in this trial.

3 PHYSIO-CHEMICAL ANALYSIS

During paneer development fat, CLR, pH, acidity, moisture, SNF and fat on dry basis of raw milk, whey and paneer was checked using various equipments.

3.1 Fat

Milk fat was determined by using Gerber method. In this method 10 ml acid pipette was used to transfer 10 ml of concentrated sulphuric acid into the butyrometer. Then the butyrometer was filled with 10.75 of milk. 1 ml of iso amyl alcohol was added using 1 ml tilt measure and closed. The butyrometer was then kept in the shaker stand till no white particles are seen and it was inverted few times. The butyrometer was put in the water bath for 5 min and dried with a cloth. The two butyrometers were kept diametrically opposite and centrifuged at the maximum speed for 4 minutes. The lower end of fat column was brought to main graduation and the reading was noted down.

3.2 Corrected lactometer reading (CLR)

The sample of milk was thoroughly mixed and brought to a temperature between 27°C to 28°C. The lactometer was immersed into the cylinder carefully and slowly. When lactometer becomes stationary, scale reading was observed. It was taken from the line on the scale which is in level with the surface of the milk.

3.3 Titratable Acidity

For checking the acidity of whey, 10 ml of whey sample was taken in beaker. And 1-3 drops of phenolphthalein indicator was added and titrated against 0.1 N sodium

hydroxide. The acidity can be calculated from the equation 3.1.

$$(3.1) \quad \text{Acidity (\%)} = X * 0.09 \text{ (ME)} \quad (3.1)$$

Where, X= Titrated value after titration
ME= milli-equivalent of lactic acid

3.4 pH

pH is an essential measurement in the paneer making process. pH of coagulated milk sample and whey sample of paneer was determined by using digital pH meter. pH value decides whether the paneer will be soft or hard. pH is also checked during coagulation time and whey analysis of sample. During coagulation time and whey analysis pH stays within 4.6-5.0 range. Decreasing the pH level will affect the paneer characteristics.

3.5 Moisture content of paneer

Initial weight of Petri plate was noted and 3g of paneer sample was weighed in the same Petri plate and kept in hot air oven for 4 hours maximum. The final weight was noted down. The moisture content was calculated using formula given in equation 3.2.

$$\text{Moisture (\%)} = \frac{\text{Initial wt.} - \text{Final wt}}{3g \text{ (wt of fresh paneer sample)}} \times 100 \quad (3.2)$$

3.6 Total solids

Total solids can be determined using the moisture content of paneer by the formula stated in equation 3.3.

$$\text{TS (\%)} = 100 - \text{Moisture} \quad (3.3)$$

3.7 Solid Not Fat (SNF)

Solid not fat was found out for milk and whey sample for determination of its quality. The equation is stated in 3.4.

$$\text{SNF (\%)} = \text{TS} - \text{Fat (Paneer)} \quad (3.4)$$

3.8 Fat on dry basis

Fat on dry basis of paneer was determined from paneer fat and total solids value. The equation is stated in 3.5.

$$\text{Fat on dry basis (\%)} = \frac{\text{Fat}}{\text{TS}} * 100 \quad (3.5)$$

4 RESULTS AND DISCUSSIONS

4.1 Effect of coagulation concentration on paneer

(3.1)

Coagulant used for this trial was acetic acid, citric acid, lactic acid and malic acid at 1%, 1.5% and 2%. Compared to the other treatments, paneer which was prepared using citric acid and lactic acid trial was not good at 1%, 1.5% and 2% concentration. This paneer showed pasty texture and it was also not coagulated properly. Paneer trial which was conducted using malic acid and acetic acid at 1% had good physico-chemical characteristics.

Table - 1: The effect of coagulant on acid consumption

S. No	Coagulant	Sample	Spice	Coagulate temp	Concentration of acid	Consumption of acid (for 1 L)	Result	PannerYt (kg)
1	CA	S	D	83°C	1%	1L	Texture break	-
	LA					1L	Texture break	-
	MA					900ml	Coagulated	0.382
	AA					950ml	Coagulated	0.371
2	CA	O	D	83°C	1%	1L	Texture break	-
	LA					1L	Texture break	-
	MA					900ml	Coagulated	0.368
	AA					910ml	Coagulated	0.432
3	CA	B	D	83°C	1%	1L	Texture break	-
	LA					1L	Texture break	-
	MA					1L	Coagulated	0.398
	AA					1L	Coagulated	0.456
4	MA	S	D	83°C	1%	910ml	Coagulated	0.387
		O				880ml	Coagulated	0.399
		B				1L	Coagulated	0.372
5	AA	S	D	83°C	1%	925ml	Coagulated	0.392
		O				900ml	Coagulated	0.420
		B				980ml	Coagulated	0.401

S-Sage leaves, O-Oregano leaves, B-Borage leaves, D-Direct addition of spices, F-Filtered addition of spices, MA-Malic acid, CA- Citric acid, LA- Lactic acid & AA- Acetic acid

Compared to the other treatment, paneer which was prepared from dry oregano leaves using malic acid consumed less amount of acid (880 ml) whereas other treatments consumed more than 900 ml of acid. Large amount of acid consumption was found in the paneer prepared from acetic acid (980 ml). Yield was higher in the sample which was prepared from oregano leaves and spices using acetic acid (0.420kg).

4.2 Physico-chemical characteristics of paneer

Paneer analysis was done to determine the moisture, fat and fat on dry basis of paneer sample. The Physico-chemical characteristics is presented in the table 2.

Table - 2: Physico-chemical characteristics

S.No	Coagulant used	Sample	Moisture (%)	Fat (%)	TS (%)	SNF (%)	Fat on dry basis (%)
1.	Malic acid	Sage	48.5	26	51.5	25.5	50.48
		Oregano	50.1	25	49.9	24.9	50.1
		Borage	60.5	27	39.5	12.5	68.35
2.	Acetic acid	Sage	51.5	23	48.5	25.5	47.44
		Oregano	47.8	27	52.2	25.2	51.92
		Borage	55	26	45	19	57.7

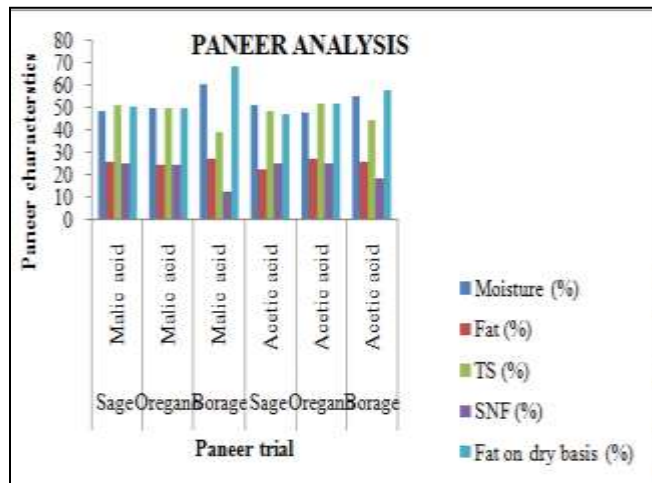


Chart - 1: Physico-chemical characteristics of Paneer

From the figure 6 it was observed that oregano and spiced paneer showed good moisture, fat % and fat on dry basis when malic and acetic was used as a coagulant. According FSSAI fat on dry basis of sample should be above 50% and not to exceed above 70%. Sage and spiced paneer sample showed good moisture and fat percentage. But Indian borage trial sample had more moisture and fat percentage. Compared to all trials oregano spiced paneer using malic and acetic acid was found good from the results obtained from paneer analysis.

4.2 Textural Analysis

Texture analysis of each trial sample was done using standard procedure used in the industry.

Table - 3: Textural analysis of paneer sample trial

S. No	Coagulant used	Sample	Brittleness	Cutting	Piercing	Slicing	Shredding	Boiling
1.	MA	Sage	Good	Good (Hard)	Good	Fail	Fail (Pasty)	Fail
		Oregano	Good	Good	Good	Good	Good	Good
		Borage	Good	Fail	Fail	Fail	Fail (pasty)	Fail
2.	AA	Sage	Good (Hard)	Good	Fail	Good	Fail	Fail
		Oregano	Good (Hard)	Good	Good	Fail	Fail (pasty)	Good
		Borage	Fail (Pasty)	Fail	Fail	Fail	Fail	Fail

4.3 Sensory analysis of paneer sample

The optimized sample was subjected to sensory analysis by sensory panellist using nine point hedonic scale. Deep fried oregano spiced paneer sample were given to panellist without addition of any flavour enhancer and masala. The paneer sample picture is given in the figure 6. The report of sensory analysis given in the table 4.



Fig - 6: Fried paneer sample for sensory

From the figure 7, it was observed that three digit code used for this paneer sample. It represents the same herbal and spiced paneer sample but produced from different coagulation acid (Malic acid and acetic acid).

Table - 4: Sensory analysis

S.No	Characteristics	Acetic acid Oregano spiced paneer	Malic acid Oregano spiced paneer
1	Appearance	7.4	8.0
2	Color	6.9	7.8
3	Texture	7.2	8
4	Flavour	6.9	7.9
5	Taste	7.9	8.5
6	Overall acceptability	7.3	8.1
7	Mean value	7.2	8.0

From the table 4, it was observed that most of them accepted malic acid paneer sample using oregano and spices. The overall acceptability of malic acid oregano spiced paneer was higher (8.1) compared to acetic acid oregano spiced paneer sample (7.3). Because malic acid paneer sample was soft in texture and good mouth feel when it was tasted and also this paneer sample showed good textural characteristics compared to acetic acid paneer sample using oregano leaves and spices. Using this data radar chart was plotted and it was given in the Chart-2

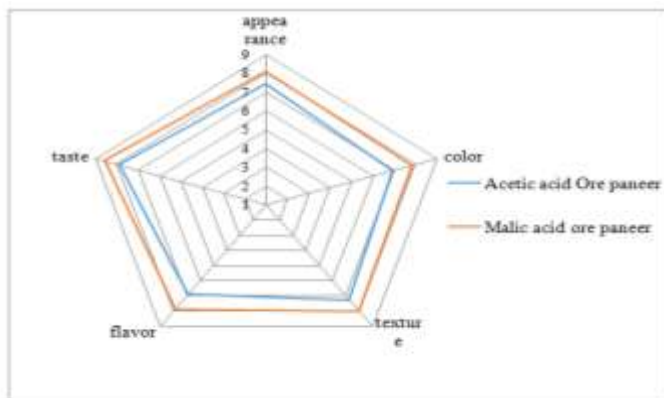


Chart - 2: Radar chart of sensory

4.4 Microbial result

Paneer microbial test was done to check the shelflife of the paneer sample. According Food Standard Act maximum coiliform count in the paneer sample should not be more than 90 (CFU/μg) and also maximum Total plate count should not be more than 2 lakh in paneer sample. Different paneer trial was done using different acids and herbs.

From the sensory characteristics and sensory analysis, malic acid paneer using oregano leaves and spices was optimized and taken for the microbial study. Industrial paneer sample taken as a control. The result of microbial count values are given in table 5.

Table - 5: Microbial test result

Sample	0 th day		5 th day		14 th day	
	Coliform (IP) (CFU/μg)	TPC (CFU/μg)	Coliform (IP) (CFU/μg)	TPC (CFU/μg)	Coliform (IP) (CFU/μg)	TPC (CFU/μg)
Oregano	<10	5500	<17	8000	<20	10000
Control	<55	10000	<75	15000	<60	20000

From the microbial test result, 0th day of dried oregano leaf paneer samples using malic acid showed less than 10 CFU/μg of coliform in the plate. Total plate count of this malic paneer sample showed 5500 CFU/μg count. Control paneer sample showed less count of coliform (<55 CFU/μg) and TPC (10000 CFU/μg).

From the 5th day of microbial test result of all these paneer, Malic acid showed less coliform count and TPC result was little higher when compared to 0th microbial result. Control sample showed <75 CFU/μg of coiliform count and 15000 CFU/μg of TPC count.

From the last 14th day of shelf life study malic acid paneer sample showed less than 20 CFU/μg coliform count and control shown <60 CFU/μg coliform count. But the TPC result of malic acid paneer sample and control sample count was slightly higher from 0th and 5th day. But this count is within the limits of TPC count and the range was below the limit of maximum count of TPC. Quality of the paneer was good upto 14th day.

The paneer was found to be within the acceptable limit of microbial count and its texture was also found to be good for upto 14 days which confirmed that the product is consumable and the shelf life of paneer was equal to commercial product. The growth of microorganism in the developed product and control sample given in the chart 3.

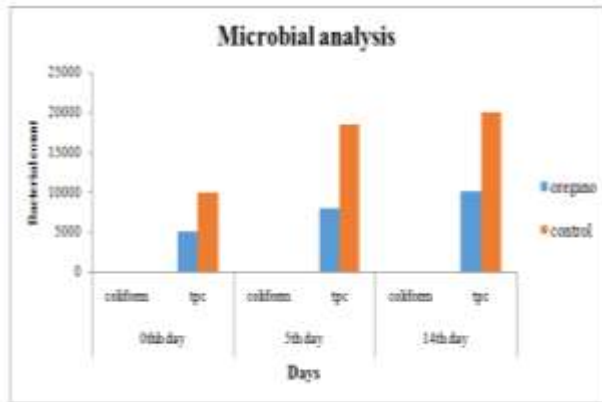


Chart - 3: Microbial analysis chart

4.5 Nutritional analysis of developed product

Nutritional analysis was done for the optimized sample. The developed paneer sample was given to Abitek lab for testing of paneer. The result of nutritional analysis is presented in figure 06. Developed product was compared to industrial sample which showed slight difference in nutritional values. From the result of nutritional analysis, vitamin A content of sample is 4% and calcium level 19.82%. The Industry sample has no vitamin A and calcium level was 20%. This nutritional analysis values given in the table 6.

Table - 6: Nutritional analysis

sample	Energy kcal	Carbohydrate (g)	Sugar (%)	Protein (g)	Calcium (mg)	Vitamin A (%)
Developed product	236.8	1.53	0	32.54	199.0mg	4
Control sample	232.4	1.20	0	32.4	120.0mg	0

5. CONCLUSION

Herbed and spiced paneer was developed using medicinal leaves such as Sage, Oregano, Indian borage and three different traditional spices such as garlic, ginger and chili flakes. The incorporation of spices was during coagulation temperature of milk sample. The spices addition has enhanced mouth feel and taste of the paneer sample. Different coagulant acid were used for this production (malic acid, acetic acid, lactic acid and citric acid). From the paneer trials, it was observed that oregano spiced paneer

using malic acid as a coagulant sample had good physio-chemical and microbiological characteristics when compared paneer samples prepared with other acids.

The effect of coagulation temperature, coagulation acid and concentration of acid on pH, acidity of whey and textural characteristics of paneer were studied. Different coagulation temperatures such as 75°C, 80°C and 83°C were tried for paneer production. At 83°C for 10 minutes, better results were observed when compared to other coagulation temperatures. Coagulant acid (citric, malic, acetic and lactic acid) were used for the paneer production at 1%, 1.5% and 2% concentration. 1% concentration showed better results in terms of coagulation and paneer texture. In case of malic acid, the paneer prepared from 1% malic acid was found to have higher yield, good color, flavor and taste. It also had good shelf life when compared to other coagulants.

The nutritional analysis of the developed product was done and it was compared with industrial paneer sample. Developed oregano spiced paneer showed higher nutritional value when compared to the industrial sample. Hence a functional milk product with higher nutritional value was developed.

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