



STUDIES ON DEVELOPMENT OF FUNCTIONAL MILK

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Abstract:

Background: At present the dairy industry is both actively and articulately involved in product development. This includes new formulations and imitation product designed to compete with or replace existing products based on their superiority inconvenience, cost, quality and health benefits, so the progress in product development. The fast going lifestyle of humans is one of the reasons for health related diseases. So attempt was made to develop functional milk by using the combination of lemongrass and clove both having medicinal properties.

Method: Optimization for pasteurized homogenized toned milk with different concentrations of sugar (6 – 10%), lemongrass (0.1 – 3%) and clove (0.05 – 0.4%) were prepared separately and with combinations and subjected for sensory evaluation.

Result: Among the different concentrations of sugar, lemongrass and clove with 8:1:0.1 combination ratio gives higher appreciation by the sensory panel.

Conclusions: The functional milk has positive effect in improvement of sensorial parameters like taste, mouth-feel, stability and overall acceptability. Addition of lemongrass and clove may play vital functional role in the developed product.

Keywords: Milk, Functional Milk, Sugar, Lemongrass, Clove, Optimization.

Introduction

Nutritionists recognize milk and its products as important constituents of a well-balanced, nourishing human diet. Milk has been described as nature's nearly perfect food in that it provides vital nutrients like proteins essential fatty acids, vitamins, minerals and lactose in balanced proportions. (Anthony *et.al.*, 2013)

Milk is regarded as rich source of nutrients as it contains high quality proteins, lactose, and flavour enriching fat. The perfect composition of milk not only recommends itself for growing children but also suited to satisfy energy needs of adult. In flavoured milks sugar, flavouring agents, colouring matters are added. Milk also provides protection against ill health and promotes good health. (Berry, 2003)

Recently, herbal products either in the form of cosmetics or food has become more popular in the world market. Epidemiological data as well as in-vitro studies strongly suggest that food containing phyto-chemical with anti-oxidation potential has

strong protective effect against major disease risks including cancer and cardiovascular disease, (Kaur and Kapoor, 2002).

Lemongrass (*Cymbopogon citratus*) is a widely used herb in tropical countries; especially in it is used in aromatherapy. Some of the reported phytochemicals are essential oils that contain citral α , citral β , nerolgeraniol, citronellal, terpinolene, geranyl acetate, and myrcene and terpinolmethylheptenone. Two triterpenoids, cymbopogone and cymbopogonol and flavones identified as luteolin and its 6-C-glucoside have also been isolated from leaves of *C. Citratus*. (Hasimet *al.*, 2015). The plant also contains reported phytochemicals such as flavonoids and phenolic compounds, which consist of luteolin, isoorientin 2'-O-rhamnoside, quercetin, kaempferol and apiginin. The compounds identified in *C. citrates* are mainly terpenes, alcohols, ketones, aldehyde and esters. Studies indicate that it possesses various pharmacological activities such as anti-amoebic, anti-bacterial, anti-diarrheal, anti-filarial,

anti-fungal and anti-inflammatory properties. Various other effects like anti-malarial, anti-mutagenicity, anti-mycobacterial, antioxidants, hypoglycemic and neurobehaviorial have also been studied (Hasim *et al.*, 2015).

Clove (*Syzygium aromaticum*) is one of the most valuable spices that has been used for centuries as food preservative and for many medicinal purposes. This plant represents one of the richest source of phenolic compounds such as eugenol, eugenol acetate and gallic acid and possess great potential for pharmaceutical, cosmetic, food and agricultural applications. The biological activities of clove and eugenol. A new application of clove as larvicidal agent is an interesting strategy to combat dengue which is a serious health problem.

The addition of antibacterial and aromatic supplements, to reduce the spoilage, can be added to the milk and also medicinal plants like lemongrass containing phytochemicals and spices like clove having antibacterial, antimicrobial properties were used for the development of the functional milk having functional properties and nutritional value like functional food.

Materials and Methods

Part 1: Selection & Physiochemical, Microbial Analysis of Raw Materials:

All the raw materials were procured from the local market of Kolhapur and it's physico-chemical, microbiological analysis (Only of milk) completed using standard method of AOAC. The results obtained are tabulated in the below tables.

1. Pasteurized homogenized toned milk

Table: 1 Physical parameters of pasteurized Homogenized toned milk

Sr. No	Parameters	pasteurized homogenized toned milk
1	Colour	White
2	Flavour	Pleasant and clean
3	Taste	Clean and slightly sweet
4	Appearance	Liquid

Table 2: Chemical parameters of Pasteurized homogenized toned milk

Sr. No	Parameter	Pasteurized homogenized toned milk
1	Acidity(as Lactic acid)	0.126 %
2	Fat (by Gerber)	3.0 %
3	Solid not fat (SNF) by gravimetric method	8.53 %
4	Protein(Pyne's methods)	3.06 %
5	pH (at 25°C)	6.65
6	Phosphatase test	Negative
7	M.B.R.T test	6.00 hrs
8	Calcium	150 mcg
9	Phosphorus	100 mcg
10	Sodium	50 mcg
11	Thiamine (Vitamin B1)	42.5 mcg
12	Riboflavin (Vitamin B2)	120 mcg
13	Niacin	100 mcg
14	Vitamin A	7.5 mcg

Table: 3 Microbial parameters of Pasteurized Homogenized toned milk

Sr. No	Parameters	pasteurized homogenized toned milk
1	SPC and TPC	7500 cfu/ml
2	Coliform	Nil /0.1ml
3	E.Coli	Absent /ml

2. Lemongrass

Table 4: Chemical Analysis of Lemongrass leaves

Sr. No.	Parameter	Lemongrass leaves
1	Moisture	11.35 ± 0.01%
2	Ash	7.15 ± 0.21%
3	Carbohydrates	19.64 ± 0.51gm
4	Protein	22.59 ± 0.01%
5	Fat	2.43 ± 0.04%
6	Crude Fibre	37.53 ± 0.67%
7	Vitamin A	1.25 ± 0.02 mcg
8	Vitamin C	2.43 ± 0.06 mcg
9	Vitamin B1	2.33 ± 0.04 mcg
10	Vitamin B2	0.23±0.06 mcg
11	Manganese	2.57±0.04 mcg

Note- Data are expressed as mean ± standard deviation of triplicate experiments (n=3). Vitamins, minerals expressed per 100 gm sample. And Vitamins, minerals expressed per 100 gm sample.

Table: 5 Qualitative tests for Phytochemical of Lemongrass leaves

Sr. No	Phytochemical components	Test	Observation	Inference
1	Alkaloids	Wagners dragendi offs test	Reddish brown test	+ ve
2	Saponin	Frothing test	Stable froth emulsion	+ ve
3	Tannin	Acid test	Reddish brown	+ ve
4	Glycoside	Sodium Picrate	Yellow dish to reddish	+ ve
5	Sterol	Salkowsk is test	Red color not interface	-ve
6	Phenol	Ferric chloride	Greenish brown precipitate	+ ve
7	Flavonoids	Sodium hydroxide	Yellow color	+ ve

3. Clove

Table: 6 Chemical Analysis of clove powder

Sr. No.	Parameter	Clove Powder
1	Moisture	14.8±0.20 %
2	Ash	12.6±0.10 %
3	Carbohydrates	41.3±0.30 gm
4	Protein	12.4±0.20%
5	Fat	16.2±0.30 %
6	Crude Fibre	17.5±0.20 %
7	Vitamin K	3±0.04 mcg
8	Vitamin C	1.692±0.005 mcg
9	Manganese	196.8±0.020 mcg
10	Calcium	117.5 mcg
11	Iron	8.3±0.003 mcg

Note- Data are expressed as mean ± standard deviation of triplicate experiments (n=3) and vitamins, minerals expressed per 100 gm sample.

Table: 7 Qualitative tests for Phytochemical of clove powder

Sr. No	Phytochemical component	Test	Observation	Inference
1	Alkaloids	Wagnersdragendi offs test	Reddish brown test	+ ve
2	Saponin	Frothing test	Stable froth emulsion	+ ve
3	Tannin	Acid test	Reddish brown	+ ve

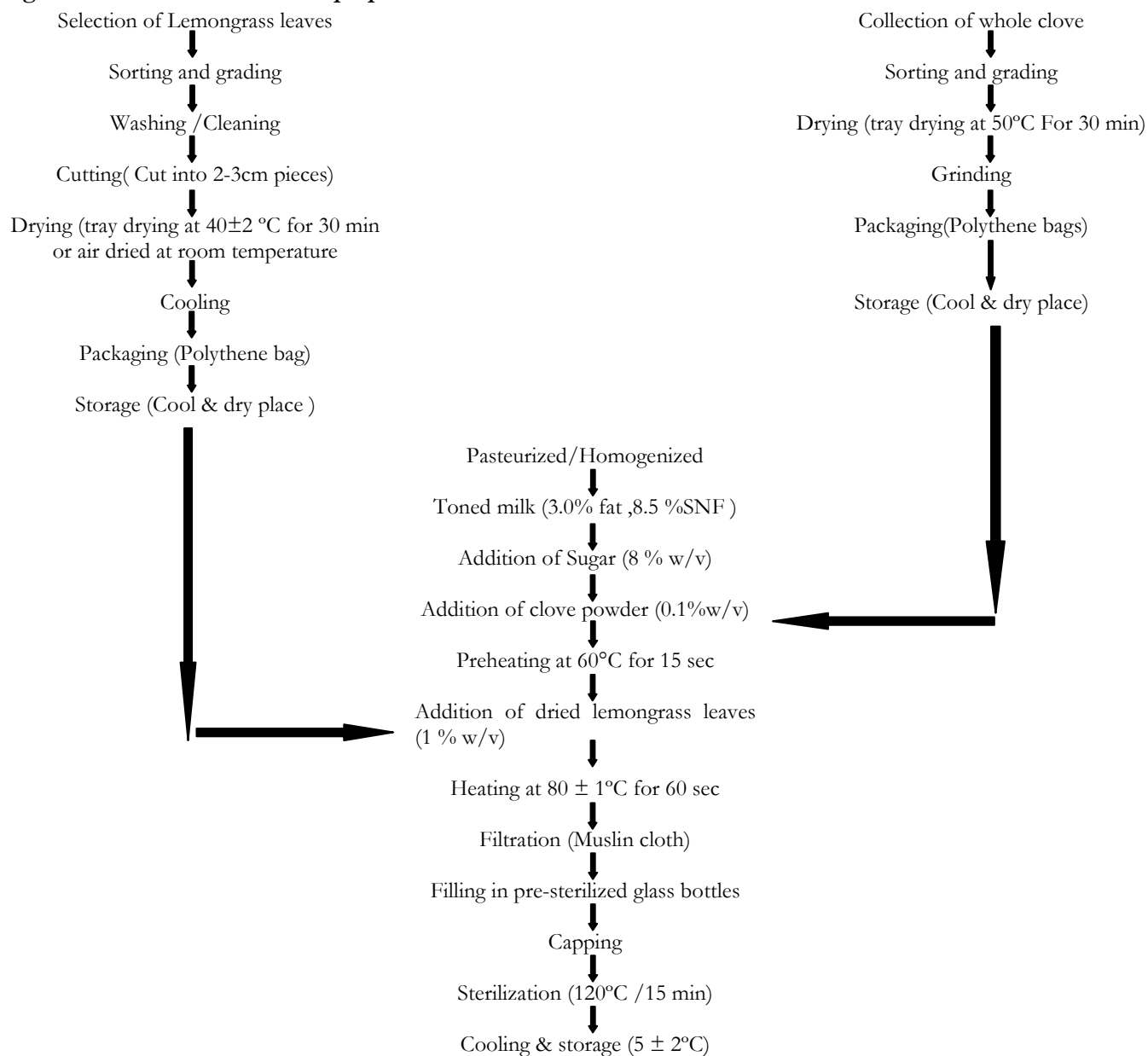
4	Glycoside	Sodium Picrate	Yellow to reddish brown	+ ve
5	Sterol	Salkowsk is test	Red color interface	+ve
6	Phenol	Ferric chloride	Greenish brown precipitate	+ ve
7	Flavonoids	Sodium hydroxide	Yellow color	+ ve

Table: 8 Physical Parameter of Sugar

Sr. No	Parameters	Sugar
1	Colour	White
2	Appearance	Crystalline solids
3	Taste	Pleasant and sweet
4	Extraneous Matter	Free from extraneous matter and smell

Part 2: Preparation of Functional Milk

Figure 1: Process flow chart for preparation of Functional Milk



Ref. (Olorunnisola *et al.*2014)

1. Preparation of Control Sample and optimization of clove powder, lemongrass leaves

Control sample were prepared by optimization of pasteurized homogenized toned milk with sugar with different concentrations of sugar.also clove powder and lemongrass leaves were prepared

using method mentioned in the flowchart and separate optimization of them with pasteurized homogenized toned milk for different concentrations were conducted and Results were analyzed for sensory parameters as per 9 point hedonic scale respectively.

Table no. 9 Optimization with sugar

Trial Percentage(w/v)	Appearance	Color	Flavor	Taste	Consistency	Overall Acceptability
6 %	6.5	7.5	7.0	7.0	7.5	7.0
7 %	7.5	7.5	8.0	8.0	8.0	8.0
8 %	8.0	8.0	8.5	8.5	9.0	8.5
9 %	7.5	7.5	8.0	8.0	7.5	8.0
10 %	7.0	7.0	6.5	6.0	7.0	6.5

Sugar concentration added in various different formulations.

Observation- 8% (W/V) concentration were selected due to it's better results.

Table no. 10 Optimization of clove powder

Trial Percentage (w/v)	Appearance	Color	Flavor	Taste	Consistency	Overall Acceptability
0.05 %	7.5	7.0	7.0	7.0	7.5	7.5
0.1	8.0	8.0	8.5	8.5	8.0	8.5
0.2	7.5	7.5	8.0	8.0	7.5	7.5
0.3	6.5	7.0	6.5	6.5	7.0	6.5
0.4	6.5	6.0	6.5	6.0	6.0	6.0

Clove powder is used for the preparation of functional milk over the clove oil which forms emulsion of the oily layer when optimized with milk.

Observation- 0.1% (w/v) concentration was selected due to its better results of sensory and overall acceptability.

Table no. 11 optimization of dried lemongrass leaves

Trial percentage (w/v)	Appearance	Color	Flavor	Taste	Consistency	Overall Acceptability
0.1	7.5	8.0	6.5	6.5	7.5	7.0
0.5	7.0	7.5	7.0	7.0	7.5	7.0
1	8.0	8.0	8.0	8.5	9.0	8.5
2	8.0	8.0	8.0	8.0	8.0	8.0
3	8.0	8.0	7.0	7.0	7.5	7.5

4. Development of Functional Milk

Functional milk was prepared using the pre-optimized concentrations of raw materials by following the steps mentioned in the flowchart.

5. Packaging of Functional Milk and storage

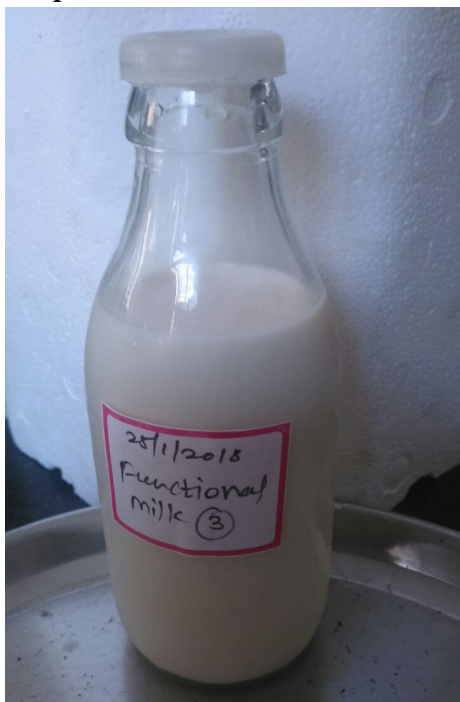
200 ml glass bottles were procured from the dairy industry packaging material suppliers with caps and were pre –sterilized in hot air oven for 2 hrs at 120°C prior to filling functional milk. Filled bottle were again sterilized for 15 min at 120 °C in hot air

oven to improve the shelf life of product. bottles were stored under 3- 6°C.

Dried lemongrass leaves are used for the preparation of functional Milk rather than the fresh leaves as dried leaves have more strong Flavour and aroma.

Observation- 1% (w/v) concentration were selected due to its Better results for sensory characteristics.

Figure.2 Prepared Functional Milk



Results and Discussion

Prepared functional milk was analyzed for physicochemical, microbiological parameters and qualitative phytochemical screenings were also tested.

1. Sensorial changes

Table no. 12 Optimization of functional milk

Sample Parameters	Functional milk prepared
Appearance	8.5
Colour	9.0
Taste/Flavour	8.5
Mouth feel	9.0
Consistency	9.0
Overall Acceptability	9.0

Sensorial analysis of prepared functional milk were showed better results for consistency, stability, improvement in flavor and taste due to the addition of clove and lemongrass as compared with the control sample.(table no.12).

2. Nutritional Improvement

Additional vitamins and minerals values were observed which were absent in raw material pasteurized homogenized toned milk. (table no.13).

Table no. 13 Chemical and nutritional analysis of prepared functional milk

Sr. No.	Parameters	Functional Milk
1	Moisture(by calculation)	71.50 %
2	Total solids (by gravimetric method)	18.50 %
3	Protein (by Pyne's method)	3.03 %
4	Fat (by Gerber)	2.80 %
5	Acidity (as Lactic acid)	0.135 %
6	PH	6.45
7	Calcium	78.40 mcg
8	Sodium	49.45 ±0.05 mcg
9	Manganese	0.046 ± 0.004 mcg
10	Iron	0.002 ±0.0005
11	Phosphorus	151.20 mcg
12	Thiamine (B1)	42.1 ± 0.04 mcg
13	Riboflavin (B2)	118±0.06 mcg
14	Niacin	98.98 ± 0.02 mcg
15	Vitamin A	31.70 ± 0.05 mcg
16	Vitamin C	0.033 ± 0.002 mcg
17	Vitamin B 9	0.010 ± 0.005 mcg
18	Vitamin E	0.010 ± 0.005 mcg
19	Vitamin K	0.014 ±0.006 mcg

Note- Data are expressed as mean ± standard deviation of triplicate experiments (n=3) & vitamins, minerals expressed per 100 gm sample.

3. Shelf life Improvement

There were little reduction in TPC count and also MBRT test of functional milk is little more than Pasteurized homogenized toned milk used. which is proportional to shelf life of the product.

Table no. 14 Microbial Analysis of functional milk

Sr. No	Parameters	Functional milk
1	SPC and TPC	7000 cfu/ml
2	Coliform	Nil /0.1ml
3	E.Coli	Absent /ml
4	MBRT Test	6:45 hrs

4. Addition Of Functional Properties

Table No.15 Comparison qualitative tests for phytochemical

Sr. No	Phytochemical components	Test Name	Observations	Results		
				Lemongrass leaves	Clove powder	Functional milk
1	Alkaloids	Wagners dragendi offs test	Reddish brown test	+ ve	+ ve	-ve
2	Saponin	Frothing test	Stable froth emulsion	+ ve	+ ve	-ve
3	Tannin	Acid test	Reddish brown	+ ve	+ ve	+ ve
4	Glycoside	Sodium Picrate	Yellow to reddish brown	+ ve	+ ve	+ ve
5	Sterol	Salkowsk is test	Red color interface	-ve	+ve	- ve
6	Phenol	Ferric chloride	Greenish brown precipitate	+ ve	+ ve	-ve
7	Flavonoids	Sodium hydroxide	Yellow color	+ ve	+ ve	-ve

Phytochemical present in medicinal plants and spices play vital role in exhibiting functional properties which are useful against the health related problems. Prepared functional milk showed positive results for some phytochemicals which was positive in lemongrass leaves and clove powder. This concludes that prepared functional milk had functional properties to use it as functional food.

Conclusion and Scope

The conducted study suggests that, pasteurized homogenized toned milk can effectively combined with different concentrations of medicinal plants like lemongrass and spice like clove to produce a option for functional food having highly acceptable sensorial parameters ,nutritive value ,good shelf life and functional properties of better health.

Commercialization of this study with market survey will add an innovation in dairy industry due to it's high potential value and present lifestyle of human beings.

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