PROCESSING AND EVALUATION OF FUNCTIONAL PANEER FROM COCONUT MILK (*COCOS NUCIFERA L.*)AND COW MILK BLENDS

Abstract

Paneer is an Indian traditional milk product which occupies an important place as a base product for the production of various culinary preparations.Paneer is nutritious and wholesome food. It provides one of the methods of conserving, preserving and prolonging shelf life of milk solids in highly concentrated form.For coagulation of milk 1% of lime juice was used. Naturally its contain citric acid. The shelf life of the developed product during room temperature (3 days) and refrigerated condition. The growing public awareness about nutrition and health care research strengthen the potential of health beneficial properties of functional foods. So there is in need to identify newer sources of nutritional materials with the desirable functional characteristics. With the current upward trend in national and international health awareness among the consumers, the demand for functional food has increased.This has forced the food industry for launching indigenous dairy products in the market with acceptable sensory characteristics. The present study was under taken with different levels (90:10, 80:20, 70:30) of cow milk and coconut milk.Chemical quality (moisture, fat, protein, and yield) and microbial quality (TPC, yeast and mould, coliform) were also analyzed. The functional coconut *paneer* with 90:10 ratio of cow milk and coconut milk was found to be best among others. Thus as far as product acceptability judged by organoleptic evaluation the treatment can be rated as P0 > P1> P2> P3. The fresh cow milk *paneer* (P0) chemical constituents were 50.78 g of moisture, 0.22% of acidity, 5.3 of pH, 20.39 g of protein, 22.8 g of fat, 0 g of fibre, 198 mg /100 g of calcium, 2.2 mg /100 g of iron respectively. The functional coconut *paneer* prepared by 10% coconut milk blending with 90% cow milk, the P1 sample chemical constituents were 52.05 g of moisture, 0.20% of acidity, 5.6 of pH, 20.55 g of protein, 23.75 g of fat, 0 g of fibre, 192 mg /100 g of calcium, 3.12 mg of iron respectively. The overall acceptability score was observed as highly acceptable with score point of 8.4±0.70in P1 when compared to control P0 was 8.1±0.73. The unit cost production of 100 g of the functional coconut *paneer* was Rs.25/100gwhereas control was Rs.22/100 g of packets respectively.

Key words: Paneer, Functional Coconut milk, blending, TPC, Sensory evaluation and Coliform.

INTRODUCTION

Coconuts (*Cocos nucifera* L.) is commonly called " **tree of life** " because of the myriad uses. It is classed as a fruit and frequently confused for being a nut, the coconut is actually a one seeded drupe. It provide a good potential source of proteins with good nutritional value and a relatively well-balanced amino acid profile. World production of coconut averaged about 51.01 billion nuts. It is a highly valued ingredient in our eating practice for its enormous

medicinal benefits. However, due to its high lipid and saturated fat content it is discouraged in the diet of patients suffering from cardiovascular ailments and hypertension. (Subha Ganguly, 2014).

Coconut production and processing have been the predominant economic activities in rural communities in many tropical regions of South-east Asia, the South Pacific and to a lesser extent the west coast of Africa. Traditionally, production of coconut oil from "**copra**" (dehydrated coconut meat) has been the largest economic sector of the coconut industry (Hagenmaier, 1977). The new products developed from coconut could potentially be of desirable nutritional composition especially in relation to cholesterol inducing fat levels, being as it is that the saturated fat content in coconut milk has been shown to be a good saturated fat, easily metabolized to give the body quick energy (Timmen&Patton, 1989).

Coconut also has important anti-carcinogenic and anti-pathogenic properties and is less likely to cause weight gain than poly unsaturated oils (Coconut Research Centre, 2004). Coconut fat helps to maintain a healthy ratio of omega-6 (w-6) and omega-3 (w-3) fatty acids, when consumed as a part of a diet. Coconut milk, a white opaque liquid, is an emulsion of natural oil in water, extracted from shredded coconut endosperm either with or without the addition of water (Simuang *et al*., 2004).

While cow's milk has equal amounts of oil and proteins, coconut milk has ten times more oil than proteins Coconut milk is considered as a valuable food for people having nutritional deficiencies since it has significant amount of Vitamin C, adequate natural minerals, and a high quality protein. Very little are still known about the coconut proteins as studies are focused on its high oil content which has also showed many health benefits (Carandang, 2008). Vitamins C, E, and B vitamins are abundant in coconut milk, and It is also rich in magnesium, potassium, phosphorous and iron. Coconut milk is lactose free, unlike cow milk, and can be used as a milk substitute by those with lactose intolerance.

Paneer is popular indigenous variety of soft cheese (David, 2009).It is highly popular traditional Indian Dairy product which is obtained by acid and heat coagulation of milk. Bureau of Indian Standards (BIS 1983) imposed maximum of 60% moisture and minimum of 50% fat in dry matter for *paneer* It is used in a variety of forms viz. base for variety of culinary dishes. *paneer* is marble white in appearance with somewhat spongy-body, close-knit texture possessing sweetish-acidic nutty flavour (Vera and Mathur, 1986; Bandyopadhyay and Mathur, 1987). ***Paneer*** is highly nutritious since it remains about 90 % fat and protein, 50 % minerals and 10 % lactose of the original milk. About 5 % of the total milk produced in India is converted to *paneer* (Mathur,1995).**76.8% calcium** and **68.3% magnesium** of the original milk retained in *paneer*. It is popular indigenous variety of soft cheese (David, 2009).Over and above its high protein content and digestibility, the biological value of protein in *paneer* is in the range of 80 to 86 (Khan and Pal 2011).India has emerged as the largest milk producer in the world with 132.4 million metric tonne milk production in 2012-13 (15% of the world's total milk) (NCAER, 2012). Out of this, an estimated 7% of milk produced in India is converted to *paneer.Paneer* is wholesome food. It provides one of the methods of conserving, preserving and prolonging shelf-life of milk solids in highly concentrated form.

Therefore, this research study is aimed at increasing the utilization of coconut milk in *paneer* making and it improving the nutritional composition of *paneer*. The objective of this study was to investigate the chemical composition, sensory evaluation, microbial parameters and shelf life of functional coconut *paneer*.

MATERIALS AND METHODS

This chapter deals with the materials used and methods followed during the course of the study for **Development of Functional *Paneer* from Coconut milk (*Cocos nucifera L.*)and Cow milk Blends.** The methodology adopted to the experiment under three aspects *viz.*, (i) To Select the coconut variety for extraction of coconut milk. (ii) To Standardize and development of functional coconut product (*paneer*). (iii) To analyse the physico-chemical quality and microbial parameters of functional coconut product (*paneer*). (iv) To assess the shelf life of functional coconut product.

METHODS

Selection of coconut variety

The coconut variety (Tall) was selected based on their quality for extraction of coconut milk from the local areas in Madurai.

Standardization of functional coconut product (*paneer*)

The coconut *paneer* was prepared with blending of coconut milk with cow milk such as 10%, 20%, 30% of coconut milk , 90%, 80%, 70% of cow milk, and 1% of lime juice for citric acid to test its taste, texture &flavour through organoleptic evaluation for different treatments (Po, P1, P2, P3).

The standardization process schedule used for trial

List 1. Details of different treatments using Coconut milk for preparation of *Paneer*

Materials %	Different treatments for Coconut *Paneer*			
	P0	**P1**	**P2**	**P3**
Coconut milk	-	10	20	30
Cow milk	100	90	80	70

List 2. Preparation of the product from cow milk (Po)

S.No	**Ingredients**	**Quantity**
1.	Cow milk	1000 ml
2.	Lime juice	10 ml

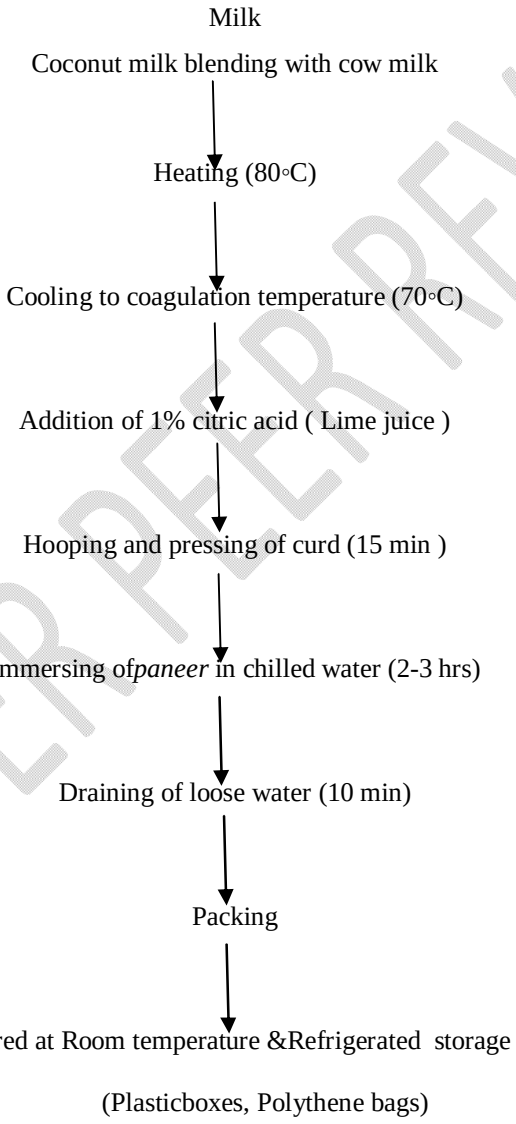
List 3. Preparation of the functional coconut product from coconut milk blending with cow milk (P1)

S.No	**Ingredients**	**Quantity**

1.	Cow milk	900 ml
2.	Coconut milk	100 ml
3.	Lime juice	10 ml

Development of the product

Chart 1. The flow chart for the preparation of functional coconut *paneer* is as follows



PROXIMAL ESTIMATION OF CHEMICAL PARAMETERS

Moisture

The moisture content of the samples was estimated by hot air oven method as per the procedure given by AOAC (1995). Weigh accurately 2 g of the sample into the previously dried and weighted dish. Add 4 ml of hot distilled water and mix. Add 1 ml of hot distilled water to wash the particles adhering to the sides of the dish. Place the dish in the oven maintained at 102^{o}C for 4 hours. Oven drying was continued till we obtain concordant values. Dried samples were cooled in a dessicator and further used for measurement of weight.

Calculation

$$\text{Moisture (\%)} = \frac{\text{Loss in weight}}{\text{Weight of the sample}} \times 100 = \frac{(W_2 - W_3)}{(W_2 - W_1)} \times 100$$

W1 = Initial weight of empty plate

W2 = Weight of empty plate + sample before drying

W3 = Final weight of empty plate + sample after drying

Protein

Principle

The blue colour developed by the reduction of the phosphomolybdic-phosphotungstic components in the Folin –ciocalteau reagent by the amino acids tyrosine and tryptophan present in the protein plus the colour developed by the biuret reaction of the protein with the alkaline cupric tartrate are measured in the Lowry's method.

Reagents

i. Folin –ciocalteau reagent (**reagent D**)-reflux gently for 10 hours a mixture consisting of 100g Sodium tungstate (Na2WoO4.2H2O), 25g Sodium molybdate (Na2WoO4.2H2O), 700ml water, 50ml of 80% phosphoric acid, and 100ml of concentrated hydrochloric acid in a 1.5L flask. Add 150g lithium sulfate, 50ml water and a few drops of bromine water. Boil the mixture for 15 min without condenser to remove excess bromine. Cool, dilute to 1L and filter. The reagent should have no greenish 20% Sodium carbonate in 0.1N sodium hydroxide (**Reagent A**).

ii. 0.5% Copper Sulphate (CuSO4.5H2O) IN 1% potassium sodium tartrate **(Reagent B)**

iii. Alkaline copper solution.: Mix 50ml of A and 1ml of B prior to use (**Reagent C)**

iv. **Protein Solution (Stock Standard)**

Weigh accurately 50mg of bovine serum albumin (**fraction V**) and dissolve in distilled water and make up to 50ml in a standard flask.

v. **Working Standard Solution**

Dilute 10ml of the stock solution to 50ml with distilled water in a standard flask. 1.0 ml of this solution contains 200µg protein.

Procedure

Extraction of protein from Sample

Extraction is usually carried out with buffers used for the enzyme assay. Weigh 500mg of the sample and grind well with a pestle and mortar in 5-10mL of the buffer. Centrifuge and use the supernatant for protein estimation.

Estimation of Protein

1. Pipette out 0.2, 0.4, 0.6, 0.8 and 1.0ml of the working standard into a series of test tubes.
2. Pipette out 0.1 ml and 0.2 ml of the sample extract in two other test tubes.
3. Make up the volume to 1.0 ml in all the test tubes. A tube with 1.0ml of water serves as the blank.
4. Add 5.0 ml of reagent C to each tube including the blank. Mix well and allowed to standing for 10mins.
5. Then add 0.5 ml of reagent D, Mix well and incubate at room temperature in the dark for 30min, blue colour is developed.

Take the reading at 660nm. Draw a standard graph and calculate the amount of protein in the sample.

Fat

The fat content of the sample was estimated by the method described by Cohen (1917). The lipid in the sample was extracted with petroleum ether (60-80°C) in Soxplus apparatus for two hours. Then the solvent was evaporated and the remaining residue was weighed. The fat content was expressed as percentage.

Calculation

$$\text{Fat (\%)} = \frac{(W_3 - W_2)}{W_1} \times 100$$

W1= Weight of sample used

W2 = Weight of flask W3 = Weight of flask with fat residue

MINERALS

Preparation of ash solution for estimation of minerals

One gram of samples were acid digested using triple acid (nitric, sulphuric, perchloric acids in the ratio 9:2:1) by keeping in sand bath until getting a clear solution and filtered through Whatman No. 41 ash less filter paper. The filtrate was made up to 100 ml and the obtained triple acid extract (ash solution) was used for the estimation of calcium, magnesium, phosphorus and other micro nutrients such as iron, zinc, manganese and copper.

Iron

The clear extract of prepared triple acid extracts was fed into the Atomic Absorption Spectrophotometer (AAS). The absorption of light by the atoms of the element in the vaporized sample was related to the concentration of the desired metal (iron) in it. The concentration was measured by using the wavelength of 248.33 nm. The concentration of the iron in the solution was measured by comparison with absorbance measurements on standards of known composition.

Calcium

Estimation is carried out by the versenate method. A 10ml of triple acid extracted sample added 10% NaoH drop by drop and 5 ml added to maintain the pH at 12. Added pinch muroxide indicator. Titrated against 0.02N ETDA (colour changed from pinkish red to purple or violet.

$$\text{Calcium content} = \frac{0.0004 \times \text{titre value}}{\text{Volume of extracted (ml)}} 100 \times 1000$$

Estimation of pH

The ph of the sample was estimated by the method of described by Hart and fisher (1971). 10 grams of the sample was mixed well by stirring with 50 ml of distilled water using glass rod and the pH of the suspension was determined in the pH Meter.

MICROBIAL ANALYSIS

The microbial quality of the *paneer* was enumerated by the method described by Istavankiss (1984). The microbial load such as total plate count for bacteria, yeast and mould count, coliform count and yeast and mould on 0 day and 3rd day of storage was analyzed based on the procedure given below.

Preparation of medium

Plate count agar was used for enumeration of total aerobic bacteria, Malt Extract agar medium was used for enumeration of yeast and mould, coliforms were enumerated using Violet Red Bile Agar.

Evaluation of microbial quality of *paneer*

One ml of the sample was taken for microbiological enumeration and serially diluted. Dilution of 10^5 and 10^6, 10^3 and 10^4, and 10^3 and 10^4 was taken for bacteria, yeast and mould count and coliforms respectively. One ml of the serial dilutions of the samples was taken in petriplates and appropriate media was added for the specific organisms. Plates were

incubated at room temperature for 24 to 48 h for bacteria, coliforms and 3 days for yeast and mold and the colonies were counted and expressed cfu/g.

ORGANOLEPTIC EVALUATION

The prepared coconut milk blending with cow milk functional *paneer* was evaluated organoleptically for various quality attributes such as colour, texture, flavour, taste and overall acceptability, by a panel of 10 trained and untrained judges using 9 point hedonic scale as per the procedure given by Watts *et al*. (1989).

COST ANALYSIS

Cost analysis of cow milk *paneer* and 10% of coconut milk blending with 90% of cow milk to produce the product like functional coconut *paneer* were determined systematically.

STORAGE STUDIES

The shelf life qualities of the developed products were assessed for a period of 7 days. Two sets of all the products (each containing 100g) were kept in a Packaging material (plastic boxes, 80 gauge polythene bags) for a period of 7 days under Room temperature and Refrigerator storage respectively.

RESULTS AND DISCUSSION

This study deals with the blending of coconut milk with cow milk to improve the nutritional quality of *paneer*. The main purpose for using the coconut milk is due to their nutritive value and to study their acceptability in dairy products. In order to evaluate the quality and acceptability of functional coconut milk *paneer*, the chemical analysis as well as organoleptic evaluation were determined.

Table: 1 Different treatment using Coconut milk for preparation of *Paneer*

Materials %	Different treatments for Coconut *Paneer*			
	P0	**P1**	**P2**	**P3**
Coconut milk	-	10	20	30
Cow milk	100	90	80	70

The table 1 is showed that P0, as control *paneer* in which only cow milk was used while in other samples 10%, 20%, 30% of coconut milk blending with 90%, 80%, 70% of cow milk and that *paneer* named as P1,P2 and P3.

Nutritional Compositions of Fresh Cow Milk *Paneer*

Table: 2. Nutritional Composition of Fresh Cow milk *Paneer* (100g)

Product	**P0**
Moisture (g/100g)	50.78 g

Protein (g/100g)	20.39 g
Fat(g/100g)	22.8 g
Acidity	0.22 %
CHO	1.4 g
pH	5.3
Iron (mg/100g)	2.2 mg
Calcium (mg/100g)	198 mg

The table 2 showed that the fresh cow milk *paneer*nutritional compositions were 50.78 g of moisture, 0.22% of acidity, 5.3 of pH, 20.39g of protein, 22.8 g of fat, 0 g of fibre, 198 mg /100 g of calcium, 2.2 mg /100 g of iron respectively. The moisture and protein contents increased with decrease in fat content of *paneer*. Similar findings were reported in *paneer* by Ashraf Pal and Yadav (1992) and Singh and Kanawjia (1988)and the control (T0) had highest moisture of 64.45 percent and experimental *paneer* (T3) had the lowest average moisture of 56.69 percent (Manual in Dairy Chemistry, ICAR 1972).

Table : 3 Nutritional Compositions of Functional Coconut *Paneer* (100g)

Parameters	P1
Moisture (g/100g)	52.05 g
Protein (g/100g)	20.55 g
Fat(g/100g)	23.75 g
Acidity	0.20 %
CHO	1.8 g
pH	5.6
Iron (mg/100g)	3.12 mg
Calcium (mg/100g)	192 mg

The table 3 revealed that the functional coconut *paneer* prepared by 10% coconut milk blending with 90% cow milk, the P1 sample chemical constituents were 52.05 g of moisture, 0.20% of acidity, 5.6 of pH, 20.55 g of protein, 23.75 g of fat, 192 mg /100 g of calcium, 3.12 mg of iron respectively.Experimental *paneer* (T3) had highest average protein of 30.58 percent whereas (T1) had lower average protein control of 26.17 percent (AOAC 1980).Control (T0) had highest fat of 14.64 percent and experimental *paneer* (T1) had the lowest average fat of 11.62 percent **(**AOAC 1980).

Organoleptic Evaluation of the Standardized Product

A sensory property of this dairy product was assessed as the sensory evaluation and consumer acceptance is a desirable criterion for a product before launching it in the market. Sensorial evaluation of each sample was done in terms of colour and appearance, consistency, flavour, taste and overall acceptability. Nine point hedonic scale was followed for conducting the sensory evaluation of fresh cow milk *paneer* and functional coconut *paneer*. The panel of 10 trained and untrained judges comprising of professors and students of Department of Food Science and Nutrition, Home Science College and Research Institute, TNAU, Madurai were selected to evaluate the products for sensory parameters. The samples were presented to judges and plain water was given to them to rinse their mouth in between the evaluation of the samples. The average score value of each combination was taken (Table 4).The change in the quality attributes directly influenced the organoleptic evaluation scores.

- P1 - 90% of Cow milk + 10%of Coconut milk + 1% Lime juice
- P2 - 80% of Cow milk + 20%of Coconut milk + 1% Lime juice
- P3 - 70% of Cow milk + 30%of Coconut milk + 1% Lime juice

Table : 4 Organoleptic Evaluation of the Standardized Product

Parameters	**Score**			
	P0	P1	P2	P3
Colour&appearance	8±0.67	8.2±0.79	8.4±0.70	8.3±0.82
Flavour	8±0.47	8.2±0.92	8±1.15	7.8±1.23
Texture	8.2±0.79	8.0±0.57	7±0.94	7.1±0.88
Taste	8.1±0.74	8.4±0.70	7.6±1.17	7.5±1.08
Overall Acceptability	8.1±0.73	8.4±0.70	7.8±1.03	7.7±1.20

Shelf Life Study

Shelf life study

The shelf life of the developed products were assessed for a period of 7 days. Two sets of all the products (each containing 100g) were kept in a packaging material (plastic boxes, 80 gauge polythene bags) for a period of 7 days under Room temperature and Refrigerator storage respectively. Both the sets of each product were examined visually for microbial infestation and noted down the period in which first infiltration was seen. The period was taken as the shelf life of the product under norma1l room temperature and refrigeration temperature.

Table : 5 Shelf life studies of standardized paneer

S.No	Sample	Shelf life	
		Room temperature	Refrigerator
1	Control (P0)	3 days	7 days
2	Coconut *paneer* (P1)	3 days	7 days

Table 5, revealed that the shelf life of both control (P0) and functional coconut *paneer* (P1) were 3 days under room temperature and 7 days in refrigeration temperature. It shows that there is no significant change in shelf life of both the *paneer.*

Sensory analysis (quantitative and/or descriptive) is often used to assess the flavor, appearance, texture and other attributes of food products as a function of processing parameters **(Kwok *et al.*, 2000).** Yoghurt manufactured from cow and coconut milk mixtures recorded the highest levels of flavour which may be due to the good coconut flavor.

Yield of *paneer*

The yield of *paneer* was determined on the basis of weight of coagulated milk product (in grams) collected by means of muslin cloth, cow's milk produced a yield of 134 g/lit which was more than the 162 g/lit yield recorded by 10% coconut milk blending with cow milk.The cheese product was formed by the coagulation of proteins in the cow and coconut milk, thus the greater protein content the greater the yield of cheese product (Adedeji and Nwanekezi, 1987).

Microbiological Quality of the Product

Table 6 Microbial count

Microbial count	***Paneer***	
	P0	**P1**
Total Plate Count -10^6cfu ml^{-1}	42.20	34.80
Yeast &Mould Count-10^4cfu ml^{-1}	14.60	12.90
Coliform Count -10^3cfu ml^{-1}	Nil	Nil

Microbiological quality of the fresh cow milk *paneer*and functional coconut *paneer*were evaluated and the results are elaborated in table 6. Total bacterial count ranged between 34.80log 10^6cfu ml^{-1}, whereas yeast and mould count ranged from 12.90log 10^4cfu ml^{-1}, coliform count was absent throughout the storage period.

Kumar and Bector (1991) analyzed the yeast and mould counts of control *paneer* sample and found that initial count increased from 10 per g to 50 per g after 4 days and 250 per g after 7 days of storage at 15 °C. Venkateswarlu et al. (2003) reported that yeast and mould count of *paneer* 2.45 per g. Kumar and Bector (1991) reported the initial

level of coliform counts of control increased from 90 per g to 3.5×103 per g after 4 days and 8.0×106 per g after 7 days of storage.

Cost Analysis

The unit cost production of 100 g of the functional coconut *paneer* was Rs.25 whereas control was Rs.22 of packets respectively.

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