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Research Article

A STUDY ON THE PHYSIO CHEMICAL PROPERTIES OF COST EFFECTIVE PANEER DEVELOPED BY INCORPORATION OF SOY MILK AND MINT

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A B S T R A C T

The paneer developed by incorporation of mint flavour (2 percent) and soy milk at 10, 20 and 30 percent level and the resultant product were analysed for physio chemical properties and cost analysis. The output value of paneer samples were ranged from 35.80 to 67.08. The analysis of the data revealed significant difference ($P<0.05$) in the output yield of paneer samples between control and treatments and within the treatments indicating that addition of soy milk and mint flavor at different level affect the output yield. Analysis of data revealed a steady increase in the moisture percentage of paneer samples as replacement level of soy milk increased due to higher moisture retaining ability of soy protein. The analysis showed a gradual decrease in the total solids and fat content of paneer samples as replacement of soy milk increased. The statistical analysis of the data revealed to ash content, titratable acidity and pH of paneer samples showed no significant difference between control and treatment, indicating that addition of soy milk at 10, 20 and 30 percent level does not produce any significant change in the ash, titratable acidity and pH. The protein contents of paneer samples showed highly significant difference between control and treatments and within the treatments, an increasing trend in protein percentage noticed as the percentage addition of soy milk increases in paneer preparation that influences the protein content of paneer. The analysis of the fat, carbohydrate, energy values of paneer samples showed on significant difference ($P<0.01$) between control and treatments but a decreasing trend noticed as replacement level of soy milk increased. The cost of paneer prepared per litre of mixture for control and treatments indicating that when replacement level of soy milk increased the cost of ingredients per litre of mixture of paneer also decreased due to lower cost of soy milk as compared with cost of cow milk.

INTRODUCTION

India has emerged as the largest milk producer in the world with the success of the Operational Flood Programme. About 5% of total milk produced in India is converted into paneer (Chandan, 2007). Paneer represents a south Asian variety of soft cheese prepared by acid and heat coagulation of milk. It is a non-fermentative, non-renneted, non-melting and unripened type of cheese. It is very popular throughout south Asia and used in the preparation of number of culinary preparations and snacks. It is a rich source of high quality milk protein, fat, minerals and vitamins. Due to availability of different types of milk and variation in milk composition, various techniques have been developed for the production of paneer as per the requirements of the consumers with appreciable improvement in the yield and other quality characteristics. Soybean often called 'Golden miracle bean' is the world's foremost provider of protein and oil, used as health food, feed sources and industrial products. Soymilk is a creamy and a milk-like product made by soaking and grinding soybeans in water. However, the water absorption of soaked soybean is directly related to the changes in textural characteristics and grinding properties of soybeans for processing (Tangratanavale and Pan, 2003). Soybean or soymilk has always been a rich source of protein which is inexpensive (Derbyshire *et al.*, 1976) and abundantly available. Soymilk is an aqueous, white and creamy extract produced from soybeans which resembles cow milk both in appearance and consistency is a highly nutritious food drink which contains protein, fat, carbohydrate, vitamins and minerals (Maduekwe *et al*., 2013). Soymilk is also a good source of calcium and helps to avoid osteoporosis. Soluble fibre in soymilk controls blood sugar. It is good for pregnant women and lactating mothers. Soymilk reduces menopausal symptoms and bone deformities. Soya foods contain calcium, magnesium and phosphorus, which help to strengthen teeth

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and prevent nerve disorder. Soybean consumption on regular basis delays the ageing process. Soy paneer is known for its extraordinary nutritional benefits, as well as its versatility (Raja *et al.,* 2014). Soy paneer is a soft cheese-like food made by curdling soya milk with a coagulant.

Soymilk is a healthy drink and is important for people with lactose intolerance, milk allergy or out of a values choice like vegan. It not only provides protein but also is a source of carbohydrate, lipid, vitamins and minerals (Chien and Snyder, 1983). Although milk paneer is popular among consumers, it is an expensive and costing around rupees 300 per kg. Hence, it is not possible to offer milk paneer for the majority of Indian population. In this context, soy paneer can be an appropriate economical alternative to milk paneer costing low and gives all nutritional benefits.

MATERIALS AND METHODS

Fresh pooled cow milk was collected from the AAC farm, Arul Anandar College, Karumathur. Food grade soy bean, mint and two percent acetic acid were purchased from the Nilgris super market, Madurai.

Preparation of Soymilk

The soy beans of good quality were carefully selected and soaked overnight 12-18 hours, at room temperature in ultrapure water contained 0.5% NaHCO3. The soaked water was decanted and the seeds were washed with fresh water, the hulls were removed under running water by manual rubbing. Hundred grams of soaked soybean seeds per litre of water was used for grinding i.e. 1:10 (w/v). The resulting suspension was filtered through a double layered muslin cloth. The muslin cloth was wrapped around the bean pulp and squeezed till all the liquid was extracted. The filtrate obtained was boiled in water bath at 80°C. The soymilk was then cooled and refrigerated for 3 days. The flow chart for the preparation of soymilk is shown in the Figure 1.

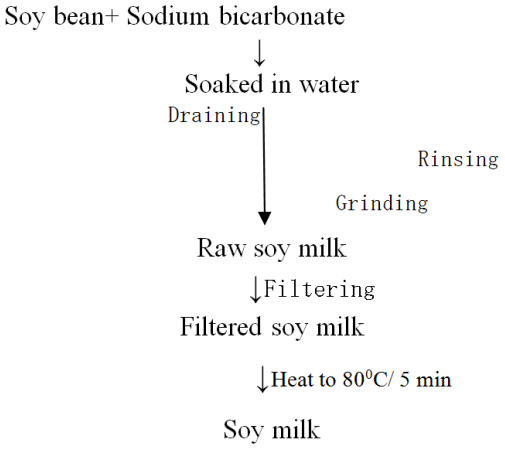
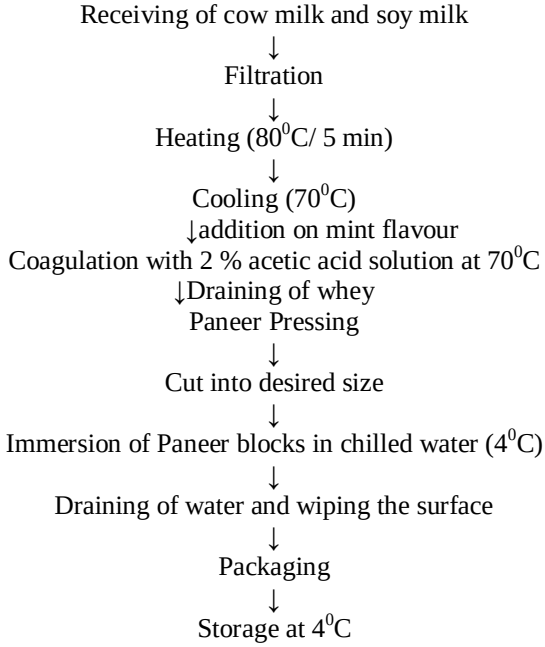


Figure 1

Methods of manufacture of paneer

The experimental trials were carried out with one litre of sample for each. A solution of 2 ml mint for flavour and 2 percent acetic acid was used to coagulate the sample. The samples were heated to coagulation temperatures of 80° C. The coagulant was added into soymilk samples slowly with gentle and continuous stirring. After complete coagulation, stirring was stopped and contents were left undisturbed at room temperature of 30^0 C for 15 min. Whey was then removed by straining through a muslin cloth. The coagulum obtained was pressed. After pressing remove the coagulated mass and soaked in cold water for 30 min. Then it was taken out and the free water on the surface was removed by wrapping paneer blocks on a clean muslin cloth. The method adopted in the preparation of soy paneer is shown in Figure 2.

Figure 2 Flow diagram for preparation of Soypaneer with a mint flavor



Treatment Details

Treatment combination used for preparation of soy milk paneer as detailed blow

Trial	Milk percentage	Percentage of soy milk	Mint flavour (ml)	Acetic acid percentage
Control	100	0	2	2
T1	90	10	2	2
T2	80	20	2	2
T3	70	30	2	2

TC Control - 1000 ml milk + 0 ml Soy milk + 2 ml mint + 20 ml Acetic acid
T1- 900 ml milk + 100 ml Soy milk + 2 ml mint + 20 ml Acetic acid
T2- 800 ml milk + 200 ml Soy milk + 2 ml mint + 20 ml Acetic acid
T3- 700 ml milk + 300 ml Soy milk + 2 ml mint + 20 ml Acetic acid

Compositional Analysis of the Product

The output- yield of paneer samples were measured using electronic weighing machine as per the procedure of Smita Khodke *et al.* (2014). The result of the products was expressed in grams. The moisture content by oven method was measured by BIS 10484-1983, Specification for paneer. The total solids content of the paneer samples was estimated based the procedure described in IS: 1479, 1960. The total ash content of the samples was determined as per the procedure in AOAC, 2000. The pH of the prepared paneer was determined using electronic digital pH meter (Systronics digital pH meter 335, India). The titratable acidity of paneer samples were measured by using the procedure of BIS (1981). Fat percentage was determined by Gerber's method as per the procedure as laid down in BIS: 1224 (Part II) – 1977**.** The protein content of paneer samples was determined by micro Kjeldahl method as described in AOAC, 2000**.** The carbohydrate content of the

paneer samples was estimated based on following calculation.100-[%moisture, %fat, %ash, % protein] = the percentage of carbohydrate. The energy value content of the paneer samples determined as per the procedure of Venkataramanujam and Ramanathan (1994) using bomb calorie meter.

Cost Analysis

The cost of 100 grams of control and treatment paneer samples were calculated using linear programming model based on the cost of ingredients. The cost of ingredients (in rupees) as follows Milk 40.00, Acetic acid per litre 40.00, Soy bean 49.00 and cost of preparation10.00.The experimental trials were replicated for four times and the observations obtained from all replications were analyzed statistically by using completely randomized design (CRD) as per Panse and Sukhatme (1984).

RESULT AND DISCUSSION

The output yield (g percentage) of paneer samples were TC (45.50), T1 (35.80), T2 (49.75) and T3 (67.08) for control and treatments T1, T2, and T3 respectively. The minimum output yield of 34.89 recorded in T1 and maximum value of 69.27 was recorded in T3. The mean results of the samples were ranged from 35.80 to 67.08. The analysis of the data revealed significant difference ($P<0.05$) in the output yield of paneer samples between control and treatments and within the treatments indicating that addition of soy milk and mint flavour at different level affect the output yield. The result showed a steady increase in the output yield of paneer as replacement of milk with soy milk increased. The result was in agreement with Jadhavar *et al.* (2009) reported that the yield of paneer increased as the proportion of soy milk in cow milk was increased.

The data with regard to moisture percentage of paneer samples were TC (42.85), T1 (55.88), T2 (58.43), and T3 67.43 for control and treatments T1, T2, and T3 respectively. The results of the samples were ranged from 42.85 to 67.43 per cent. Analysis of the data revealed significant difference in the moisture percentage of paneer samples between control and treatments and within the treatment. Analysis of data revealed a steady increase in the moisture percentage of paneer samples as replacement level of soy milk increased due to higher moisture retaining ability of soy protein as reported by Kinsella, (1979).

The mean total solids (g %) percentage of paneer samples were 58.81, 44.13, 41.58, and 32.58. for control and treatments T1, T2, and T3, respectively. The results of the samples were ranged from 32.58 to 58.81. Analysis of data revealed significant difference ($P<0.05$) between control and treatments and within the treatments. The analysis showed a gradual decrease in the total solids content of paneer samples as replacement of soy milk increased due to higher moisture retaining capacity of soy milk reduce the solids content in the final product. Yadav *et al.* (2003) declared that soymilk contains higher moisture than bovine milk, and their proximate constituents differ significantly between the two. The result obtained in the present study were in close agreement with Jadhavar *et al.* (2009) reported that the paneer from cow milk which had significantly ($P<0.05$) higher yield, total solids, fat and ash than those prepared from cow milk and soymilk blend and sole soy milk. The value of ash content for control and treatments were 0.90, 0.92, 0.91 and 0.90 per cent, respectively for control and treatments T1, T2, and T3. The data were ranged between 0.90 to 0.92 per cent. The statistical analysis of the ash content of paneer samples revealed no significant difference between control and treatments and within treatments, indicating that incorporation of mint and soy milk at 10, 20 and 30 percent level does not produce any significant change in the ash content of the resultant product. Smita Khodke *et al.* (2014) reported that the range of ash content in soy-groundnut paneer prepared from different proportions of soymilk and groundnut milk was 1.24 to 1.33%. The result obtained were in relation with Masrath Butool and Shadab Butool (2015).

The titratable acidity value (percentage lactic acid) of paneer samples were ranged 0.64 -1.13 for control (TC), 0.63 - 1.15 (T1), 0.63-1.15 (T2) and0.53 - 0.90 (T3) respectively. The minimum mean titratable acidity value of 0.53 recorded in T3 and maximum mean value of 1.15 was recorded in T1. Statistical analysis of the data revealed no significant difference between control and treatment, indicating that addition of soy milk at 10, 20 and 30 percent level does not produce any significant change in the titratable acidity. The acidity obtained in the present investigation for control and treatment paneer samples were closer to the values reported by EL-Boraey *et al.* (2015) and Jeelani Raja *et al.* (2014).

The data with regard to pH for control and treatments paneer are presented in table 6 and depicted in fig 6.The range of pH value for control 5.8 - 6.4 and for treatments 6.2-6.5, 6.4-6.6and 6.5-6.8for treatments T1, T2, and T3, respectively. The results of the pH samples minimum mean value from 5.8 recorded in TC and the maximum mean value recorded 6.8 was T3.Statistical analysis revealed no significant difference between control and treatments and within treatments indicating that addition or replacement of sugar and aspartame at any level having comparable pH as that of control.

The range of fat percentage of control paneer sample was 8.8 - 15.0 and for treatments T1, T2 and T3 were 7.2 - 13.0, 4.0 - 9.4 and 3.1 - 8.5 respectively. The minimum mean fat percentage recorded in T3 (5.95 ± 0.88) and maximum value recorded in TC (12.45 ± 0.93). Statistical analysis revealed a significant difference ($P<0.01$) in fat percentage of paneer samples between control and treatments but no statistical difference was notice between TC and T1 and between T2 and T3. The fat content showed a decreasing trend when replacement level of soy milk increased. Similar to the present findings, Masrath Butool and Shadab Butool (2015) also reported that low fat content in paneer as replacement level of soy milk increase was due to low fat content in the soy milk.

The protein content of paneer samples was 8.6, 9.55, 10.35, and 11.18 for control and treatments T1, T2, and T3 respectively. The minimum protein content recorded in TC (8.5) and maximum value recorded in T3 (11.6).The statistical analysis of the protein contents of paneer samples showed highly significant difference between control and treatments and within the treatments. The result showed an increasing trend in protein percentage as the percentage addition of soy milk increases in paneer preparation, that influences the protein content of paneer. The result of the present investigation revealed that as the percentage replacement of soy milk increased the protein percentage in the resultant product also increased due to high protein content of soy milk (Shurtleff and Aoyagi, 1983). The result of carbohydrate (g percentage) of paneer samples were ranged from 14.56 to

35.14 per cent. The carbohydrate (g percentage) of paneer samples were 8.6, 23.11, 14.56 and 23.86 for control and treatments T1, T2, and T3 respectively. The statistical analysis of the carbohydrate in paneer samples variance showed on significant difference (P<0.01) between control and treatments and within the treatments T1, T2 and T3. Among the treatments carbohydrate content showed a decreasing trend as replacement level of soy milk increased. This may be due to low carbohydrate content of soy milk resulting in decrease value of the carbohydrate as replacement level of soy milk increased. The findings of the present investigation were in close agreement with the report of Magrath Butanol and Shahab Butanol (2015).

The data with respect to energy value (cal/g) of paneer samples were ranged from 1804.31to 4860.00.The energy value (cal/g) of paneer sample were 4382.11 1891.74, 2064.40and 2583.10for control and treatments T1, T2, T3 respectively. The statistical analysis of energy value in paneer samples showed a significant difference (P<0.01) between control and treatments and within the treatments.

The result showed a decreasing trend as replacement level of soy milk increased. Gupta *et al.* (1977), Gandhi *et al.* (1985) reported that soy milk contain relatively high protein content and low fat percentage may be the reason for the reduction in the energy value as the replacement level of soy milk increased.

Cost Estimation

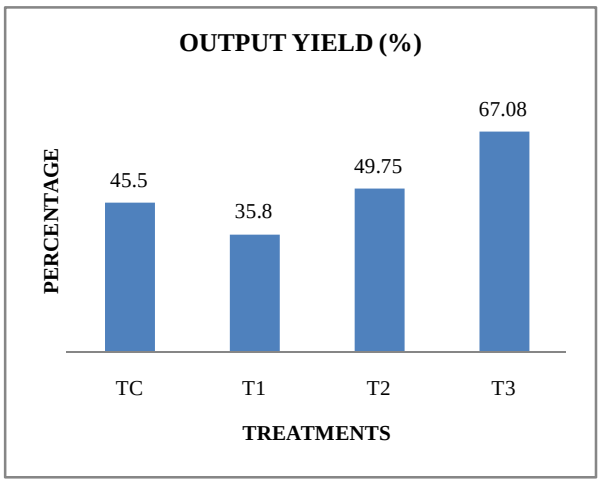
The cost of paneer prepared per litre of mixture for control and treatments indicating that when replacement level of soy milk increased the cost of ingredients per litre of mixture of paneer also decreased. When replacement level was 10, 20 and 30 per cent, the percentage decrease in cost were 8.5, 17.0 and 26.22 per cent respectively as compared to control. The decreases in cost for experimental paneer samples could be attributed to the lower cost of soy milk as compared to cost of cow milk. Gupta *et al*. (1977), Gandhi *et al.* (1985) reported that the high protein content and relatively low price of soy flour make it very attractive to many developing countries, such as India, for fortifying purposes in bread and cereal products. This is the reason for the reduction in the cost of the product as the replacement level of soy milk increased.

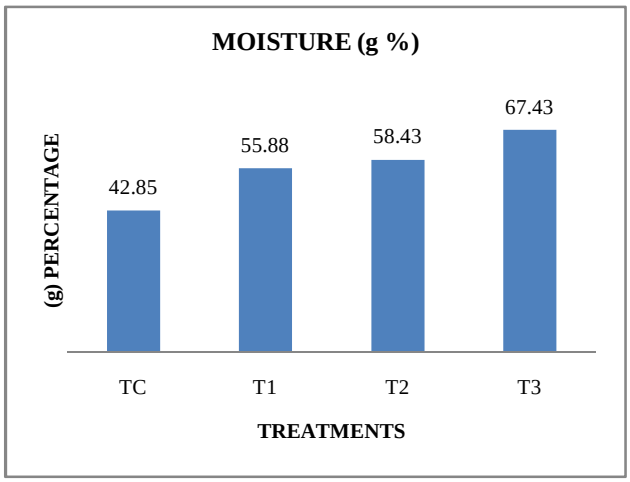
CHARACTERS		CONTROL	TREATMENTS			F- VALUE
			T1	T2	T3	
Output – Yield (g%)	Mean	a 45.50	b 35.80	c 49.75	d 67.08	258.569**
	Range	42.69-48.11	34.89-36.11	46.52-51.95	61.49-69.27	
Moisture (g%)	Mean	a 42.85	b 55.88	b 58.43	c 67.43	64.509 **
	Range	40.0 - 44.5	53.0-59.5	53.9-62.0	65.0-68.3	
Total Solids (g %)	Mean	a 58.81	b 44.13	b 41.58	c 32.58	101.092 **
	Range	53.5 – 60.0	40.5 - 47.0	38.0 - 46.1	29.5 - 35.0	
Ash (mg/g)	Mean	a 0.90	a 0.92	a 0.91	a 0.90	1.056 NS
	Range	0.84-1.0	0.82-0.98	0.82-0.96	0.81-0.95	
pH	Mean	a 6.03 ± 0.06	a 6.2 ± 0.05	a 6.43 ± 0.04	a 6.72 ± 0.05	1.355 NS
	Range	5.8 – 6.4	6.2-6.5	6.4-6.6	6.5-6.8	
Titratable Acidity (%LA)	Mean	a 0.82	a 0.79	a 0.78	a 0.66	1.041 NS
	Range	0.64 -1.13	0.63 – 1.15	0.63-1.15	0.53 - 0.90	
Fat (%)	Mean	a 12.45 ± 0.93	a 10.55 ± 0. 86	b 7.05 ± 0.88	b 5.95 ± 0.88	10.258**
	Range	8.8 – 15.0	7.2 – 13.0	4.0 – 9.4	3.1 – 8.5	
Protein (%)	Mean	a 8.6 ± 0.07	b 9.55 ± 0.15	c 10.35 ± 0.20	d 11.18 ±0.19	53.909 **
	Range	8.5 – 8.8	9.4 – 10.0	9.9 – 10.8	10.7 – 11.6	
Carbohydrate (%)	Mean	a 35.14 ± 0.27	b 23.11 ± 1.44	b 23.86 ± 1.19	c 14.56 ± 0.61	72.265**
	Range	34.02 - 36.01	19.53 - 29.78	20.71 - 29.32	13.09 - 17.42	
Energy Value (cal/g)	Mean	a 4382.11 ± 124.34	a 1891.74 ± 23.02	b 2064.40 ± 32.32	c 2583.10 ± 43.12	275.520**
	Range	3947.12-4860.00	1804.31 – 1973.52	1937.53-2177.70	2429.00 -2745.82	

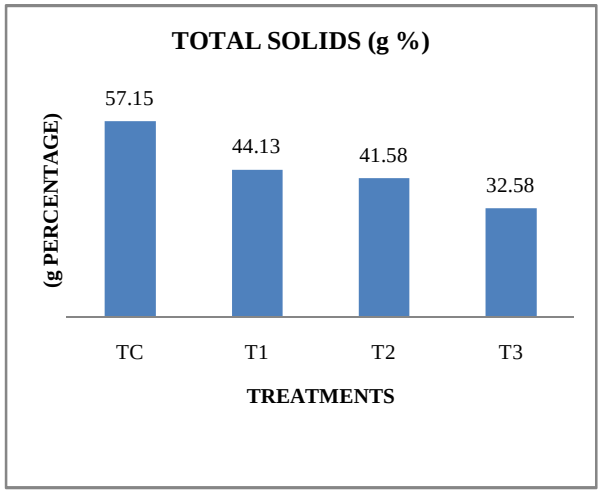
** indicating significant difference at 1% level, NS- Not significant

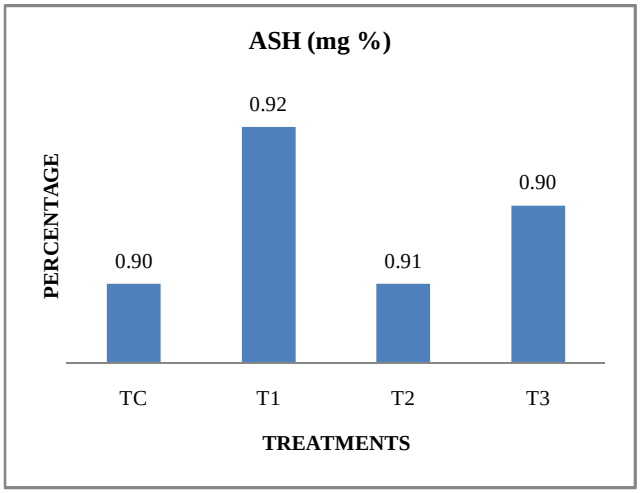
Table 2 Analysis of Cost of Production of paneer samples

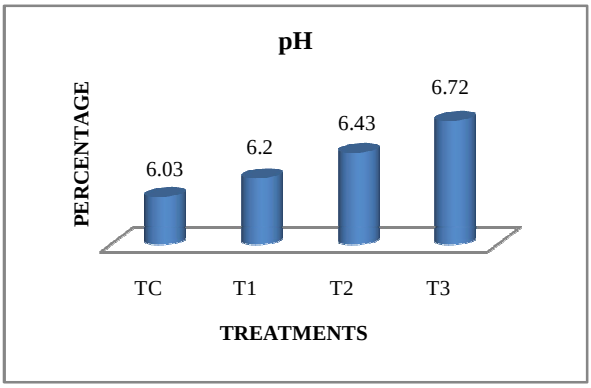
Ingredients	TC	T1	T2	T3
Milk Qty. (L)	1	0.9	0.8	0.7
Price (Rs)	40	36	32	28
Soy milk (ml) Qty.	0	100	200	300
Price (Rs)	8	0.49	0.98	1.47
Mint flavor (ml) Qty.	0.5	0.5	0.5	0.5
Price (Rs)	0.5	0.5	0.5	0.5
Total Cost (Rs)	41.30	37.79	34.28	30.47
Decrease in price (Per cent)	0	- 8.50	- 17.0	- 26.22

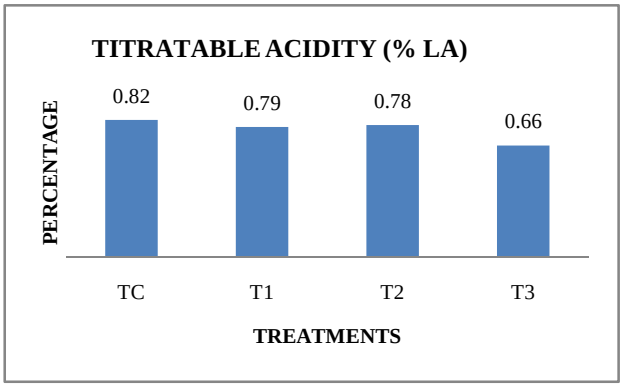

OUTPUT YIELD (%)
PERCENTAGE
45.5
35.8
49.75
67.08
TC
T1
T2
T3
TREATMENTS

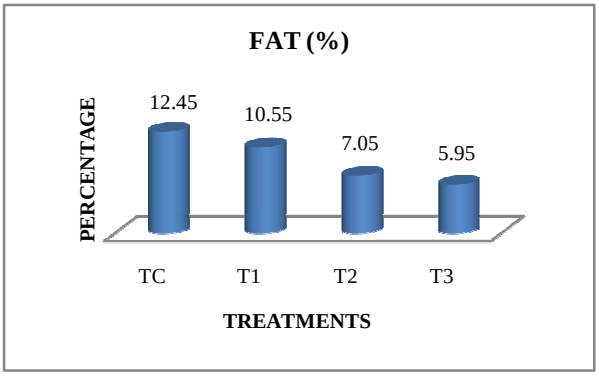

MOISTURE (g %)
(g) PERCENTAGE
42.85
55.88
58.43
67.43
TC
T1
T2
T3
TREATMENTS

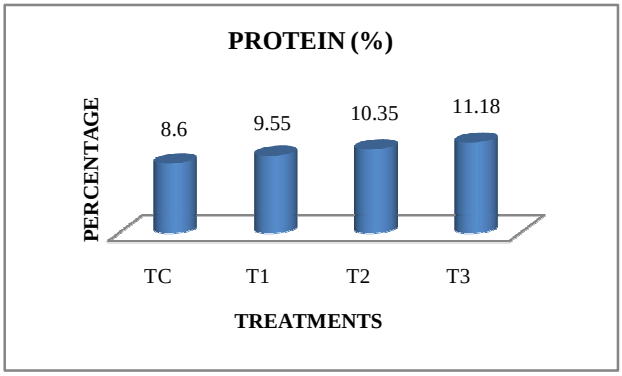

TOTAL SOLIDS (g %)
(g PERCENTAGE)
57.15
44.13
41.58
32.58
TC
T1
T2
T3
TREATMENTS

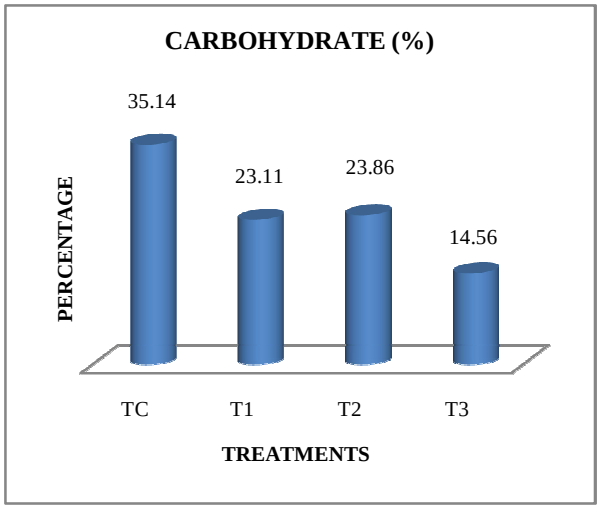

ASH (mg %)
PERCENTAGE
0.90
0.92
0.91
0.90
TC
T1
T2
T3
TREATMENTS

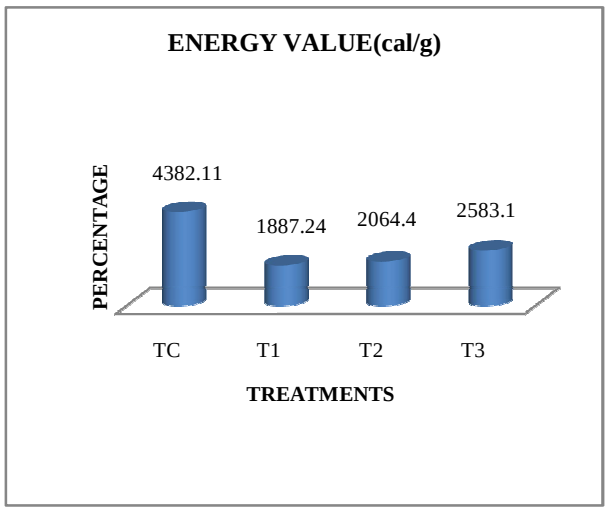

pH
PERCENTAGE
6.03
6.2
6.43
6.72
TC
T1
T2
T3
TREATMENTS

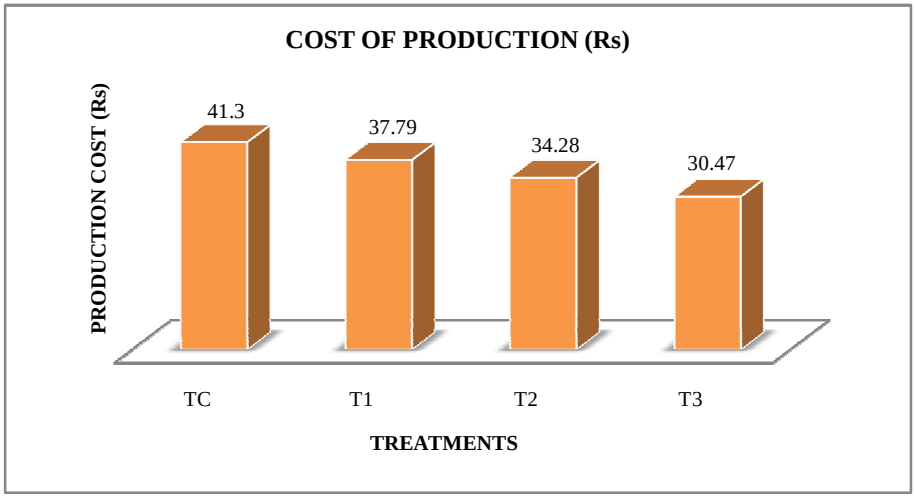

TITRATABLE ACIDITY (% LA)
PERCENTAGE
0.82
0.79
0.78
0.66
TC
T1
T2
T3
TREATMENTS


FAT (%)
PERCENTAGE
12.45
10.55
7.05
5.95
TC
T1
T2
T3
TREATMENTS


PROTEIN (%)
PERCENTAGE
8.6
9.55
10.35
11.18
TC
T1
T2
T3
TREATMENTS







Physio Chemical Characters of Paneer and Soy Paneer

Means bearing the common letters as subscript are statistically not significant**.**

TC Control - 1000 ml milk + 0 ml Soy milk + 2 ml mint + 20 ml Acetic acid, T1- 900 ml milk + 100 ml Soy milk + 2 ml mint + 20 ml Acetic acid, T2- 800 ml milk + 200 ml Soy milk + 2 ml mint + 20 ml Acetic acid, T3- 700 ml milk + 300 ml Soy milk + 2 ml mint + 20 ml Acetic acid

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