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Research paper

Optimization and Shelf-life Study of Herbal *Paneer* Incorporated with Periwinkle Powder

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ABSTRACT

Paneer is a type of Indian soft cheese that is highly nutritious and healthful and is used as a base ingredient in a wide range of culinary dishes. As a result of the constant *Paneer* is becoming increasingly popular among health-conscious people. It is vital to produce value-added variants of products for consumers *Paneer* represents a South Asian variety of soft cheese prepared by acid and heat coagulation of milk. It is a rich source of animal protein and fat. *Paneer* used commercially are without flavour's and is bland in taste. Herb periwinkle powder is rich in micronutrients and functional components for so many diseases. Therefore, in the present study, an attempt was made to develop *Paneer*, by addition of herb. *Paneer* samples were prepared with (4.5 %) fat and (8.5%) Solid not fat of milk using citric acid as a coagulant, and periwinkle powder @ 1%, 2%, 3%, incorporation for preparation herbal *paneer*. Results demonstrated that the herbal *Paneer* had a better organoleptic profile than control samples, with no or minor effects on the *Paneer*'s proximate and physicochemical parameters. The total phenolic content of the herbal *Paneer* sample was found to be significantly higher, indicating Herbs could be used to create a new functional dairy product with improved antioxidant qualities and as a result, a longer shelf-life.

Keywords: *Paneer*, periwinkle powder, storage stability, shelf-life

Paneer is an essential heat and acid coagulated indigenous product. India produced approximately 17-18% of the world's total milk production. Buffalo milk accounts for 55 of total milk output, while cow milk accounts for 40.5 %. Because of the ever-increasing demand for *Paneer* among a wide range of health-conscious consumers, it became necessary to develop value-added *Paneer* variations. Indian dairy product that is used as a base for a variety of culinary meals and snacks.

Another important issue influencing *Paneer*'s customer acceptance is its bland flavour, which might be improved by using natural extracts from herbs, spices, and grasses during *Paneer*'s manufacturing. In recent decades, consistent steps have been launched to manufacture value-added *Paneer* by utilizing advanced technology and including ingredients such as greens, herbs, and spices.

Many cultures have utilized herbs and spices to enhance the flavour and smell of dishes for thousands of years. When compared to chemical preservatives, there has been an increasing demand for the addition of herbs and spices to food and dairy products due to the possibility for improved flavour and extended

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shelf-life with no toxic effects (Oraon *et al.* 2017). Herbs and spices appeal to people who are concerned about the safety of synthetic additives because they are natural foods. Madsen and Grypa (2000) identified that herbs and spices are effective food ingredients to create and explore new tasty products. Bajwa *et al.* (2005) reported that incorporation of coriander and mint at a level of 10% by weight in *Paneer* enhanced the overall acceptability achieved and yield of product. In addition to imparting flavour, certain herbs prolong the shelf-life of foods due to their bacteriostatic or bactericidal activity and prevent rancidity by their antioxidant activity. Turmeric was incorporated into *Paneer* of 0.6%by weight of likely yield of *Paneer* prepared and was found to be acceptable and safe for usage (Singh *et al.* 2014).

Catharanthus roseus (Periwinkle) leaves have a number of health advantages, including blood sugar control, decreasing high blood pressure, menstrual irregularities, and Hodgkin's disease prevention (Bisla *et al.* 2014). Pham *et al.* (2020) reviewed over the phytochemicals derived from *Catharanthus roseus* and their health benefits. It owns various phytochemicals with various biological activities such as antioxidant, antibacterial, antifungal, antidiabetic, and anticancer properties. Das and Sharangi (2017) reviewed on the Madagascar periwinkle (*Catharanthus roseus* L.) for its diverse medicinal and therapeutic benefits to humankind. The review provided us with insights into agro-technological, biological, ecological, and medicinal aspects (mainly its anti-cancerous compounds) of Madagascar periwinkle along with the possible pathways and mode of action. Kumar *et al.* (2012) reported that *Catharanthus roseus* possesses a significant amount of volatile and Phenolic compounds to comprise caffeoylquinic acids and flavones glycosides which are known to antioxidant activity.

MATERIALS AND METHODS

For the preparation of *paneer*, fresh cow milk was procured from the Gaushala (Dairy Farm) Banaras Hindu University (BHU), Varanasi U.P., filtered and standardized to approximately (3.0%) fat and (8.5 % SNF). Fresh leaves of *Catharanthus roseus* (periwinkle) grown on the campus (BHU) were used for the research work. Low-density polyethylene (LDPE) pouches were used during the storage study.

Preparation of periwinkle powder

Powder of periwinkle leaves was made by the method given below in Fig. 1:

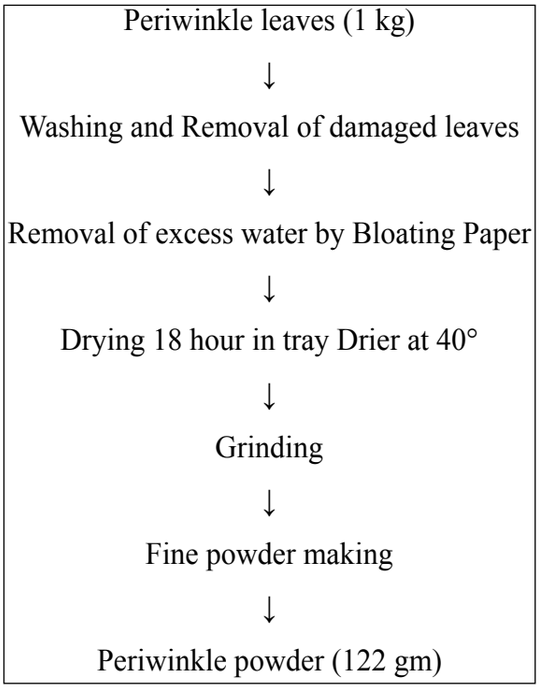

Fig. 1: Flow chart for Preparation of periwinkle powder

Preparation of herbal and control *paneer*

Levels of Periwinkle powder

T0 = control

T1 = 1% Periwinkle powder in *paneer* (w/w)

T2 = 2% Periwinkle powder in *paneer* (w/w)

T3 = 3%Periwinkle powder in *paneer* (w/w)

The preparation of herbal paneer has been shown in Fig. 2 and final optimized product (along with the control) has been shown in Fig. 3.

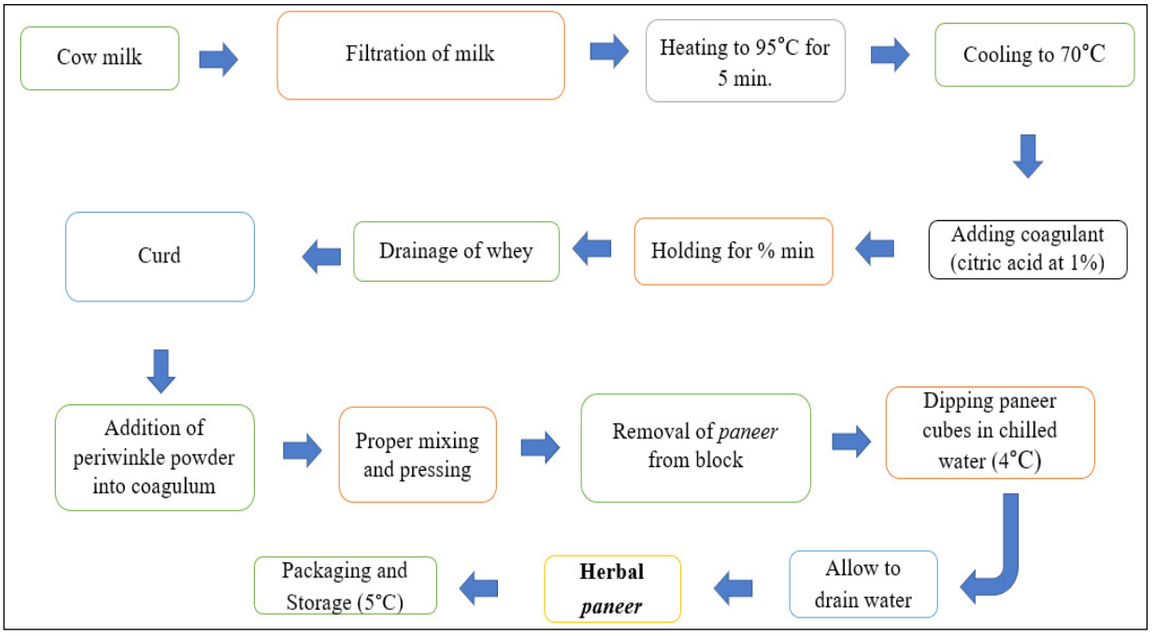

Fig. 2: Flow chart For Preparation of herbal *paneer*

Fig. 3: Control and optimized *paneer*

Physical analysis of herbal *paneer*

Surface color measurement was determined using the (L, a, b)* system by Color Flex, Hunter Lab. Bulk density was determined according to the protocol (Sahin *et al.* 2013). Where L* represents lightness, a*represents greenness, and b*represents yellowness Gumminess, cohesion, adhesiveness, and firmness/ hardness are all measured by TPA. Texture analysis was determined by a texture analyzer (TA.XT.Pulse, UK).

Proximate analysis of herbal *paneer*

Herbal *paneer* proximate analysis, including moisture content, ash content, value in herb incorporated were carried out as per the method of AOAC (2005) fat content and protein content were analyzed (AOAC 1990). Titratable acidity was carried as per the method of Rangana (2001). pH was measured using a digital pH meter (Thermo scientific, Sn 821899 Singapore). Microbial analysis was carried out according to AOAC (2005) and data were transformed into logarithms of the number of colony-forming units (CFU/ml).

Sensory analysis

Sensory evaluation of samples was complete by a panel of judges following 9-point hedonic scale ratings based on color, taste, flavor, texture, and overall acceptability. The acceptability of the product was rated based on a scale of points ranging from "like extremely" to "dislike extremely".

Analysis of bioactive compounds in herbal *paneer*

Antioxidant activity of herbal *paneer* was evaluated by 2, 2-Diphenyl-1-picrylhydrazyl (DPPH) method according to Benzie and Strain (1996). The total polyphenol content (TPC) of the periwinkle powder dried sample was evaluated using the Folin-Ciocalteu phenol reagent by the method of Huang *et al*. (2005). Gallic acid was used to prepare a standard curve (5–60 µg /ml; $y = 0.00128x - 0.3079$; $r^2 = 0.989$; y is the absorbance; x is the solution concentration).

Determination of microbial population

Microbial analysis of the optimized herbal *paneer* was determined by the method prescribed by AOAC, 2005. Total plate count, yeast and mold count, and the coliform count were determined using nutrient agar, potato dextrose agar (PDA), and VRBA (Violet Red Bile Agar) respectively to grow the microbial population.

Statistical analysis

To select of incorporation of periwinkle powder in *paneer* 3 replication was conducted for 3 trials. The value of each attribute understudy was subjected to presented as a mean with a standard deviation of the triplicate analysis. df, F value, p-value, and F crit were calculated and shown statistical analysis by one Factor analysis using MS Excel 2019.

RESULTS AND DISCUSSION

Determination of the Physical & Chemical Properties of the periwinkle powder incorporated *paneer*

As the leaves of periwinkle dry, the tray drying technique was used to make its powder and then herbal *paneer was* prepared by addition of a different amount of periwinkle powder @ 0%, 1%, 2%, and 3%, the best-accepted sample was selected and study its quality attributes.

Physical analysis of herbal *paneer*

Color

Color effects with the periwinkle powder incorporated *Paneer* are presented in (Table 2). The color was measured by hunter color in which values of L*, a*, b* were determined. The values for L* ranges from (88.95±1.40 to 83.21±0.60) while the control value was (90.27±0.01) *Paneer* greenness indicated by a negative value for a* ranges from (-0.75±0.01 to -0.43±0.01), while b* value ranges from (17.47±0.03 to 19.49±0.05) and control *paneer* sample value was (5.38±18.67). The colour was determined with the help of the hunter colour lab and values of L*, a*, and b* were determined. F value was calculated showing in Table

Table 1: Colour Analysis of Herbal *paneer*

Trial no.	L*	a*	b*
T_0	90.27±0.01	-0.75±0.01	5.38±18.67
T_1	88.95±1.40	-0.67±0.05	17.47±0.03
T_2	86.07±0.85	-0.46±0.03	18.27±0.07
T_3	83.21±0.60	-0.43±0.01	19.49±0.05
F-Value	50.56429	52.97942	2545.152
p-Value	1.52E-05	1.27E-05	2.95E-12
F Crit	4.066181	4.066181	4.066181

Values are expressed as mean ± standard deviation of three replications; S.D = 0.05, n = 3.

Table 2: Values of Textural property of Herbal *paneer*

Treatment	Hardness (N)	Cohesiveness	Springiness	Chewiness
T_0	28.66±0.093	6.64±0.004	0.85±0.008	15.48±0.044
T_1	29.69±0.129	0.58±0.040	0.8±0.0163	16.43±0.254
T_2	31.55±0.098	0.53±0.016	0.66±0.005	17.67±0.089
T_3	32.55±0.17	0.526±0.016	0.62±0.012	16.70±0.01
F-Value	393.2079	10.62333	148.8	94.88652
p-Value	5.05E-09	0.003654	2.35E-07	1.36E-06
F Cirt	4.066181	4.066181	4.066181	4.066181

Values are expressed as mean ± standard deviation of three replications; S.D = 0.05, n = 3.

Table 3: Average data for different parameters of control and herbal *paneer*

Attributes	Fat (%)	Protein (%)	Ash (%)	Moisture (%)	Total solid (%)	pH	Titratable Acidity (% lactic acid)
T_0	24.49±0.537	18.29±0.118	1.55±0.117	55.25±0.065	44.75±0.065	5.66±0.110	0.72±0.136
T_1	23.44±0.385	19.35±0.183	2.22±0.005	54.78±0.202	45.21±0.202	6.43±0.325	0.98±0.081
T_2	23.04±0.30	20.02±0.326	2.26±0.005	53.55±0.105	46.45±0.105	5.44±0.355	1.11±0.123
T_3	22.72±0.185	20.67±0.302	2.30±0.0025	52.66±0.316	47.34±0.316	5.22±0.422	1.15±0.125
F-Value	15.0275	50.64653	105.4338	106.4922	106.3348	19.16294	6.566453
p-Value	0.00119	1.51E-05	9.02E-07	8.68E-07	8.73E-07	0.000521	0.015008
F Cirt	4.066181	4.066181	4.066181	4.066181	4.066181	4.066181	4.066181

Values are expressed as mean ± standard deviation of three replications; S.D = 0.05, n = 3.

1 that there is a significant effect of the treatments on the colour of herbal *paneer*.

Textural properties of herbal *paneer*

Herbal *paneer* is affected by its textural qualities. *paneer* qualities like hardness, cohesiveness, chewiness, and springiness, and can be evaluated using the Texture Profile Analysis (TPA) approach (Bourne 1978). shown in Table 2 the mean values of hardness, cohesiveness, springiness, and chewiness of *paneer* with periwinkle powder, as assessed by the Texture Analyzer. *Paneer* samples (control and experimental) had hardness values ranging from (28.66±0.093N to 32.55±0.175N), which were not significantly different from each other. The same finding was observed for other parameters also. Herbal *paneer* was almost similar to findings of Mhatre (2007) and data similar with Shrivastava and Kumbhar (2010). There was no significant difference between control and treatment samples of *paneer* concerning cohesiveness, springiness, and chewiness. Among the samples, the values for cohesiveness varied from (6.64±0.004 to 0.526±0.016), springiness ranged from (0.85±0.008 to 0.62±0.012), and chewiness averaged from (15.48±0.044 to 16.70±0.012).

pH and Titratable acidity

Periwinkle incorporated *paneer* and control *paneer* sample mean value presented in Table 4. The pH values were also found to be slightly reducing with the Incorporation of periwinkle leaves powder. The pH ranged from (6.43±0.325 to 5.22±0.422), while the acidity was to be found to be range from (0.98±0.081 to 1.15±0.125) may be noticed that the acidity of *paneer* samples gradually increased with the addition of periwinkle powder incorporated *Paneer* sample has a low pH with higher acidity. The pH of the control sample (5.66±0.110) and acidity was found (0.72±0.136) which was in accordance with the findings of Mhatre (2018). Prajapati *et al.* (2018) confront more or less similar. It's important to note that the acidity of *paneer* samples gradually

Table 4: Sensory evaluation scores of Herbal *paneer* and Control *paneer*

Trial No.	Color and Appearance	Body and Texture	Flavor	Mouthfeel	Overall Acceptability
T_0	7.08±0.11	8.22±0.046	7.19±0.037	7.23±0.027	6.93±0.058
T_1	8.24±0.37	8.42±0.53	8.24±0.53	8.58±0.53	8.37±0.39
T_2	7.46±0.50	7.46±0.50	7.64±0.58	7.62±0.52	7.58±0.35
T_3	6.94±0.79	7.36±0.77	6.76±0.47	6.6±0.61	6.93±0.33
F-Value	4547.395	811.0348	36184.25	219.7483	49.39324
p-Value	2.9E-13	2.83E-10	7.26E-17	5.06E-08	1.66E-05
F Cirt	4.066181	4.066181	4.066181	4.066181	4.066181

Values are expressed as mean ± standard deviation of three replications; S.D = 0.05, n = 5.

increased as periwinkle powder concentrations were raised. The incorporation of acidic components from periwinkle powder rich in acidic flavor compounds into *paneer*.

Proximate analysis of herbal *paneer*

Fat

Fat value of control samples to be 24.49±0.537 while periwinkle powder incorporated *paneer* mean value ranged from 24.49±0.537 to 22.72±0.185 at a different level of concentration of a periwinkle powder. It was observed that the incorporation of periwinkle powder decreased the fat content of the *paneer*. The findings are similar to those of Mishra (2013). Mhatre (2018) discovered that adding ginger juice to *paneer* resulted in a fat reduction. F value was calculated showing that there is a significant effect of the fat value. lower fat content can make a significant contribution to dietary intake, especially in diets for diabetics.

Protein

It was observed that the protein content showed a gradual increase with the increase in the level of periwinkle powder protein mean value ranged from (19.35±0.183 to 20.67±0.302) while control *paneer* sample value (18.29±0.118) was obtained. F value was calculated showing that there is a significant effect of the protein value. 2013 similar finding Priya Mishra used several spices and salt to make *paneer*. The higher protein content can make a significant contribution to dietary intake, especially in diets for diabetics.

Ash

The ash content of the *paneer* sample was found to be in the range of 2.22±0.005 to 2.30±0.0025 while in the Control sample 1.55±0.117 value was obtained Lesser ash content was observed. Ash content showed a gradual increase with an increase in the level of periwinkle powder. The increasing trend of ash in *paneer* may be because herb powder contained a higher percentage of ash as compared to ash content in control *paneer*. F value was calculated showing that there is a non-significant effect of the ash content.

Moisture

The moisture content of the *paneer* sample was found to be in the range of the mean value (54.78±0.202. to 47.34±0.316) while in the Control sample (1.55±0.117). F value was calculated showing that there is a non-significant effect of the moisture content.

Total solid

Total solid % was found to be in a range of the mean value range from (45.21±0.202 to 47.34±0.316) while the control sample mean value was 44.75±0.065. At a different concentration of periwinkle powder F value was calculated showing that there is a non-significant effect of the total solid content.

Analysis of bioactive compound in herbal *paneer*

In Table 5, the value ranges from (78.63 0.177 to 90.290.23) for freshly prepared periwinkle powder incorporated paneer and (71.820.17) for control paneer, which could be due to the presence of native milk proteins in paneer, while periwinkle powder treated paneer DPPH value gradually increases and TPC value also increases. Significant difference among treatments. The study shows that the DPPH value and TPC value of the control *paneer* were lesser than the optimized *paneer*. The inhibitor color of the free radical compound (DPPH), and TPC determined the antioxidant activity of the herbal *paneer*. F value was calculated showing that there is a significant effect of the treatments on the antioxidant activity of herbal *paneer* (Tyagi *et al.* 2020). According to Nisar (2017), the antioxidant activity and total phenolic content in the leaves and various plant components of *Catharanthus roseus* (periwinkle) were high.

Sensory analysis

The data obtained for changes in sensory attributes of *paneer* with increasing rate of addition of periwinkle powder by various levels are presented in Table 4 The CA score of the *paneer* with periwinkle powder, was enhanced from (8.24±0.37 to 6.94±0.79) while in the control sample was (7.08±0.11) obtained and body and texture range from (8.42±0.53 to 7.36±0.77) it remained at par with the control (7.08±0.11), thereafter the score reduced during further addition. And Flavour ranges from (8.24±0.53 to 6.76±0.47) while control sample was (7.19±0.037), and mouth fell ranges from (8.58±0.53 to 6.6±0.61) in control sample (7.23±0.027) score is low (Buch *et al.* 2014; Eresam *et al.*

Table 5: Microbial attributes of herbal *paneer*

Storage day	SPC (cfu × 10^{-5} /g)	Yeast and mold count (cfu × 10^{-5} /g)	Coliform count (cfu × 10^{-5} /g)
Fresh (Control)	15.24±0.055	24.7 ±0.33	N.D
Optimized	13.24±0.065	20.4±0.22	N.D
5 days (Control)	19.14±0.066	45.9±0.43	N.D
Optimized	17.24±0.061	30.89±0.11	N.D
10 days (Control)	ND	ND	N.D
Optimized	20.24±0.066	38.8±0.05	N.D
15 days (Control)	ND	ND	N.D
Optimized	22.24±0.042	40.88±0.07	N.D

Values are expressed as mean ± standard deviation of three replications; S.D = 0.05, n = 5; ND = Not detected.

Table 6: Cost Analysis of Control and herbal *paneer*

Sl. No.	Description of Ingredient	Rate	Quantity	Cost of herbal *paneer*	Cost of control *paneer*
1	Cow Milk	45/ Liter	2 Liter	90	90
2	Periwinkle Powder	140/100 Gm	10	14	0
3	Citric Acid	900/Kg	2gm	18	18
4	Packaging Material	10/Unit	1	10	10
5	Others (labor, Fuel etc.)	10	—	10	10
6	Total cost	—	—	₹ 142	128
7	Final cost with 10% overhead	—	—	156.2	140.8
8	Product Prepared	—	—	315.6gm	315.6gm
9	Cost of 315.6 gm	—	—	156.2	140.8
10	Cost Per Kg Product	—	—	494.93	446.13

2015). The same trend was reflected in the OA score, which may be since the use of 3%leaves imparted a darkish green color to *paneer* which did not find better acceptance with the judges. Sensory properties were examined with the help of a 9-point Hedonic scale (1 = dislike extremely, 9 = like extremely) was used. Trial T_1 showed the best results for all the sensory parameters, as it had the highest mean value than the rest of the variants. Hence trial T_1 was selected as the optimized product and further physicochemical and microbial analysis was carried out on the optimized herbal *paneer* which had 1 %periwinkle powder along with the control.

Microbial analysis of herbal *paneer*

The addition of periwinkle powder shows a significant effect microbial load lesser was shown to be comparable to the control sample hence shelf-life of the optimized sample was 15 and the control sample show high microbial load.

Cost analysis of herbal *paneer*

Table 6 given showed the cost of production per Kg for the prepared herbal *paneer* and control was calculated, as ₹ 494.93/ Kg for the prepared herbal *paneer* and ₹ 446.13/ kg for the control.

CONCLUSION

The current study aimed to use herbs such as periwinkle powder to enhance *paneer* consumption and so benefit from its beneficial properties in both children and adults. Herbs also give human beings nutritional and phytochemical benefits. The present study, herb (periwinkle powder@ 1%) was incorporated and its effect on quality The latest results revealed that adding the periwinkle powder to *paneer* had a significant impact on its sensory properties. pH, titratable acidity, TSS, moisture content, ash content, fat and protein content, and other parameters and microbial load were also lesser were shown to be comparable to the control sample. Differences in phenolic content indicate that the herbal *paneer* had more phenolic compounds than the control *paneer*, indicating that the prepared herbal *paneer* is related to its health benefits. As a result, the procedure of making *paneer* with herbs like periwinkle powder is relatively feasible, and it provides a chance to use the herb as a natural preservative to extend the shelf-life of the product, thanks to the herb's antioxidant and antibacterial properties.

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