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A Study on Physico-chemical and Microbial Quality of Pectin-paneer Whey Jelly

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Abstract: *This study was carried out in order to find the suitable level of whole paneer whey for producing pectin-whey jelly and studying effects of different levels of paneer whey on product's physico-chemical as well as microbial quality. Whey- world's largest dairy by-product, is disposed raw as 'waste' because of serious and large scale problems of higher cost of treatment, lower pH, higher total solids and Biological Oxygen Demand, etc. Due to which, diversification of this byproduct into such a kind of food chain, which is irresistible by all age group people remained as an ultimate solution. For this, five different proportions of paneer whey testing average total solids (6.36 ± 0.04%), titrable acidity (0.38 ± 0.01%), pH (5.61 ± 0.11), protein (0.35 ± 0.01%) and ash (0.40 ± 0.14%) and corresponding levels of potable water was utilized for treatments viz., T1 (00:100 Control), T2 (25:75), T3 (50:50), T4 (75:25) and T5 (100:00). Blend prepared with aqueous orange colour, flavour, citric acid, pectin and sugar was concentrated up to 65°Brix. Moisture, total soluble solids, titrable acidity, pH, protein, reducing sugar, total sugar, carbohydrates and ash ranged from 34.85-30.76%, 65.10-68.20°Brix, 0.40-0.44%, 3.46-3.31, 0.03-0.25%, 10.25-14.69%, 65.01-68.50%, 65.08-68.55% and 0.09-0.42% respectively. Yeasts and molds were nil.*

Keywords: *By-product, Dairy, Pectin, Jelly, Paneer, Whey.*

INTRODUCTION

Out of 85 million tones of global production of whey, 40% is disposed raw in to sewage [7] as its Biological Oxygen Demand is very high (39000-48000 ppm) [30]. Treatment of five lakh liters of whey costs approximate $10000 every single day [18] causing serious hazards of environment pollution. Also it is not economically feasible to build a purification plant for all dairies. This leaves us with no other option but to 'utilize whey' [19]. It is considered as largest by-products of world dairy industry [6], containing approximately 6% total solids with lactose (70%) and valuable whey proteins (as much as 11%) [40], most of the water soluble vitamins, necessary minerals [30], calcium, phosphorus and all the essential amino acids, thus proving it as a highly nutritious in substance [31]. Due to this, immense work has been done in the world to utilize whey for producing hydrocolloid 'xanthan gum' [24], WPC, whey powder, lactose [6], and as an efficient carbon and nitrogen source [22] etc. Production of these substances on a large scale is not economically feasible for many dairy industries; hence diversification of whey solids at its production point to human food chain appears to be the best alternative way of utilizing whey [6]. Food industries add healthy ingredients to their products to obtain functional products which hold pique interest of consumers [37].

Especially 'jelly', can be prepared from simpler ingredients like sweetener, acid, hydrocolloid and water or fruit extract [27]. It satisfies craving for sweets and leaves with a pleasant mouth feel [25]. Jellies made from pectin have several advantages over those made from other hydrocolloids. Gelatine jellies have the disadvantage of being slow setting

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on making up by the housewife, while agar and alginate jellies often lack clarity. Storage of these jellies often results in loss of gelling strength and consequent increase in time required for setting. Pectin jellies are found to be quick setting and do not appreciably lose gelling strength on storing [3].

The power of pectin to revolutionize the structure of sol system to generate gel network along with its plant-originated nature and numerous health-beneficial properties have resulted in its ever-growing applications for creating edible gelled systems [9]. Food industry view whey products as an ideal means of achieving added value, and appreciate it well for the functional properties but paneer whey face a large number of difficulties in its use because of high mineral content and low pH, therefore it mostly remains unutilized [8]. Hence several attempts were done to obtain a balanced fusion of whey and hydrocolloid to prepare fruit jelly but were unsuccessful. Sharma and Raghuwanshi [33] also concluded that the whey cannot be utilized in preparation of fruit preserves. Rao *et al*. [29] and Sharma [32] also agreed with the results on account of the perishable nature of fruits. Patel and Arora [26] supported that the native functional properties of whey proteins and fiber functionality of pectin will synergistically increase the quality level of dairy products, thus benefiting all age group consumers. With this view, present work was aimed to find out suitability of paneer whey for pectin-whey jelly and study the effect of different levels of paneer whey on physico-chemical and microbial quality of finished product.

MATERIAL AND METHODS

Paneer whey was obtained fresh, free of cost for each replica treatments T1 to T5 from students dairy plant producing paneer by using average 1.5% citric acid solution as a coagulant. It was filtered twice using double layered sterilized muslin cloth and analyzed for total solids, titrable acidity, pH, ash and protein content as per ISI [13]. Pectin-paneer whey jelly was prepared according to the procedure demonstrated by Human [11] with slight modification. Proportions of composite sample of paneer whey and potable water were 00:100 (T1, Control), 25:75 (T2), 50:50 (T3), 75:25 (T4) and 100:00 (T5). The paneer whey –water mixture was admixed with food grade aqueous orange flavour, colour, pectin of jelly grade 150 ± 5 @ 1.5%, analytical grade citric acid @ 1% and sugar @ 47%. Mixture concentrated till total soluble solids reached minimum 65°Brix for preparing pectin-paneer whey jelly.

Each treatment was replicated five times. Average analytical values of physico-chemical properties of finished products were obtained. Soluble solids, titrable acidity, pH, reducing and total sugar of treatment T1 to T5 were calculated as per Ranganna [28] while carbohydrates were obtained by standard method described in ISI [14]. Standard Micro Kjeldahl method [2] was used to calculate protein content. Percent moisture and ash were determined as per the standard process given in ISI [12].

Microbial analysis was done according to standard procedure described by Balasubramani *et al*. [3] for standard plate count along with yeasts and molds count. Entire analytical data was recorded and statistically analyzed using one way ANOVA and Completely Randomized Design as explained by Snedecor and Cochran [34]. All the 25 samples were analyzed and average results were discussed.

RESULTS AND DISCUSSION

Analytical results of paneer whey (Table 1) are similar with those of Kumar and Saxena [20]. The average results obtained after physico-chemical analysis of fresh treatment samples are shown in Table 2. Due to the increase in total solids content because of the addition of paneer whey and total solids present in it, the lowest moisture was recorded for treatment T5. Carvalho *et al*. [5] recorded similar results for sapota pulp jelly.

Table 1
Average composition of the paneer whey

Parameters	*Average values*
Ash	00.40 ± 0.14%
Total solids	06.36 ± 0.04%
Titrable acidity	00.38 ± 0.01%
pH	05.61 ± 0.11
Protein	00.35 ± 0.01%

Table 2
Effect on physico-chemical properties of pectin -paneer whey jelly

Treatment	*pH*	*Total soluble solids (°Brix)*	*Ash (%)*	*Moisture (%)*	*Protein (%)*	*Reducing sugar (%)*	*Titrable acidity (% citric acid)*	*Carbohydrate (%)*	*Total sugar (%)*
T1	3.46 ± 0.01^{a}	65.10 ± 0.09^{e}	0.09 ± 0.01^{e}	34.85 ± 0.01^{a}	0.03 ± 0.01^{e}	10.25 ± 0.04^{e}	0.40 ± 0.01^{e}	65.08 ± 0.11^{e}	65.01 ± 0.01^{e}
T2	$3.\ 41 \pm 0.01^{b}$	65.30 ± 0.21^{d}	0.19 ± 0.01^{d}	34.28 ± 0.03^{b}	0.09 ± 0.01^{d}	12.07 ± 0.05^{d}	0.41 ± 0.01^{d}	65.43 ± 0.01^{d}	65.41 ± 0.04^{d}
T3	3.39 ± 0.01^{c}	66.73 ± 0.25^{c}	0.27 ± 0.01^{c}	32.73 ± 0.05^{c}	0.15 ± 0.02^{c}	12.98 ± 0.01^{c}	0.42 ± 0.02^{c}	66.83 ± 0.10^{c}	66.8 ± 0.06^{c}
T4	$3.\ 36 \pm 0.01^{d}$	67.46 ± 0.66^{b}	0.34 ± 0.01^{b}	31.80 ± 0.05^{d}	0.22 ± 0.02^{b}	13.49 ± 0.12^{b}	0.43 ± 0.01^{b}	67.56 ± 0.07^{b}	67.52 ± 0.08^{b}
T5	$3.\ 31 \pm 0.01^{e}$	68.20 ± 0.89^{a}	0.42 ± 0.01^{a}	30.76 ± 0.11^{e}	0.25 ± 0.02^{a}	14.69 ± 0.05^{a}	0.44 ± 0.27^{a}	68.55 ± 0.01^{a}	68.50 ± 0.12^{a}

Data represented as mean ± standard deviation. Means with different superscripts in a column differ significantly at 5% level of significance (n = 5)

Zakari *et al*. [39] found results resembling with those of pectin-paneer whey jelly samples in case of total soluble solids which in the same case were slightly lower than the findings of Kumari and Sandal [21] for mango jam samples. High soluble solids present in paneer whey itself were responsible for the increase in total soluble solids content of the treatment samples from T1 to T5. The differences among the treatments were significant for pH values which decreased from T1 to T5. This may be due to increase in acidity due to increase in levels of paneer whey. Similar values were recorded by Hossen *et al.* [10] for guava jelly and Joshi [17] for both wood apple and guava jelly.

There was increase in acidity from T1 to T5 with the increasing levels of paneer whey. The values recorded are in harmony with Islam *et al*. [15] in case of the dragon fruit jelly as indicated by the per cent citric acid calculated for different treatments.

The result indicated increase in carbohydrate content with increase in the proportion of paneer whey may be due to increase in level of total solids from paneer whey which raised the percent carbohydrates of fresh whey-pectin jelly. Similar values for per cent carbohydrates were recorded for powdered banana peel jelly [23] and sapota pulp jelly [5]. Treatment T5 recorded highest protein content because of higher whey proteins. Pectin was solely responsible for the protein value in treatment T1. The protein content recorded for treatment T4 and T5 are similar with the findings of Kumari and Sandal [21] for whey based mango jam.

The highest reducing sugar content was observed for treatment T5 and the lowest reducing sugar content recorded for treatment T1 (Control). The values of reducing sugar for pectin-paneer whey jelly prepared using 25% (T2) and 50% (T3) level of paneer whey are in accordance with values observed by Sudhagar *et al.* [35] for pear jelly. All the treatments showed statistically significant difference for ash content. The increase in ash content may be because of increasing mineral content of paneer whey with increase in its level from treatment T1 to T5. Hossen *et al*. [10] reported similar results.

Table 3
Effect on microbial quality of pectin- paneer whey jelly

Treatment	*Standard plate count (cfu/g)*	*Yeast and mold count (cfu/g)*
T1	$2.33 \times 10^5 \pm 0.39^e$	$0.0 \times 10^4 \pm 0.0$
T2	$3.59 \times 10^5 \pm 0.16^d$	$0.0 \times 10^4 \pm 0.0$
T3	$5.66 \times 10^5 \pm 0.57^c$	$0.0 \times 10^4 \pm 0.0$
T4	$7.66 \times 10^5 \pm 0.01^b$	$0.0 \times 10^4 \pm 0.0$
T5	$7.86 \times 10^5 \pm 0.18^a$	$0.0 \times 10^4 \pm 0.0$

Data represented as mean ± standard deviation. Means with different superscripts in a column differ significantly at 5% level of significance (n = 5).

The values recorded for total sugar content showed statistically significant differences among the treatments. The lowest total sugar was recorded for treatment T1 and highest for T5. The results indicated increase in total sugar content with increase in proportion of paneer whey due to increase in level of lactose in it. The values recorded are in line with Yuyama *et al*. [38], Thomas and Kulwal [36], Carvalho *et al*. [5] and Islam *et al*. [16].

The standard plate counts obtained in the present studies were higher than the values reported by Sudhagar *et al*. [35] may be due to use of lower sugar level as compared to pectin-paneer whey jelly. The values of yeast and mold count for different treatments after five replications were recorded nil (Table 3). Similar results were recorded by Carvalho *et al*. [5] and Hossen *et al*. [10]. Aleman *et al*. [1] stated that the development of micro-organisms on superficies of starch jellies was limited.

Results revealed that levels of valuable nutrients like paneer whey minerals, whey carbohydrates and whey proteins are carried successfully in jelly and goes on increasing from treatment T1 to T5 as the 'paneer whey' level increases, facilitating its use at the production point of paneer whey itself, by diverting it in human food chain, producing a novel pectin-paneer whey jelly, also mitigating problems concerning whey disposal, whey treatment, effluent treatment and environmental pollution.

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