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# Comparative Analysis of Indian Paneer and Cheese Whey for Electrolyte Whey Drink

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**Abstract:** The present study was undertaken to make crude comparison between whey obtained from paneer and cheese during manufacturing. Paneer and cheese whey were compared in terms of all the minerals as well as physico- chemical properties indispensable for electrolyte drink. The slight differences attributed, among various parameters can be mainly due the difference in manufacturing process. Our results indicated significantly higher concentration of sodium, potassium, calcium and chloride contents in paneer whey than cheese whey. The analysis is important as paneer whey can be utilized more efficiently otherwise creating environmental pollution especially in India.

**Key words:** Whey · Paneer · Electrolytes · Calcium

## INTRODUCTION

Whey, a by-product of cheese, paneer, chhana and coagulated dairy products, usually dumped because it had no value, a practice increasingly frowned upon by environmentalists [1]. In India, there has been a substantial increase in the production of paneer, resulting in an increased accessibility of whey. India's annual production is estimated at 1, 50,000 tones of paneer [2] and concerning 2 million tones of whey, containing about 1, 30, 000 tonnes of valuable milk nutrients are produced per annum [3]. Growing environmentalist concern have made dumping expensive while the development of technology has opened up new and cost effective ways of utilizing the whey constituents which has helped to find a wide range of new applications and the development of dairy industry [4].

Presence of electrolytes is very important before going for healthy whey drink because it can be use as a source of replenishment for the loss minerals. Therefore, analysis of mineral composition and physicochemical properties of paneer and cheese whey and comparison between them is indispensable to favor their utilization in healthy drinking.

## MATERIALS AND METHODS

**Collection of Whey Samples:** Paneer whey was obtained during the manufacture of buffalo milk paneer from Experimental Dairy of National Dairy Research Institute, Karnal and Market of Karnal. Citric acid was used for the coagulation of milk for the preparation of paneer. Cheese whey was collected during the cheddar cheese preparation from Experimental Dairy and Market. Whey was initially clarified through cheesecloth to remove casein particles.

**Physiochemical Properties of Whey:** Samples of whey collected were analyzed for fat, lactose, protein, ash, total solids and acidity by AOAC methods [5]. Physiochemical properties of paneer and cheese whey were determined using Standard protocols. The pH of the sample was determined using a digital pH meter (Century CP 931).

**Estimation of Electrolytes in Whey:** Paneer and cheese whey samples were analyzed for the presence of electrolytes. Sodium, potassium, magnesium, calcium and zinc in whey can be analyzed by atomic absorption spectroscopic method. The sample to be analyzed is normally ashed and then dissolved in the aqueous solution [6].

Whey samples for spectroscopy were prepared through dry ashing. Weigh accurately a suitable quantity of the well-mixed sample in a tared silica dish. Heat first over a low Bunsen flame to volatize much of the organic matter (until the material gives out no more smoke) as possible. Transfer the dish to temperature controlled muffle furnace at about 300°C until the carbon has ceased to glow and then raise the temperature to 429°C. Allow cooling and add 5ml of concentrated $HNO_3$ and 5ml of

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water, heat over the burner for few minutes to dissolve the soluble salts. Filter into 25ml volumetric flasks using Whatman No.1. Make up the volume with water as desired.

**Concentration of mineral in the sample:** mg /100ml= ppm from standard curve x volume make up x dilution x100/ weight of the samplex1000

**Analysis of Citrate in Whey:** Method of Indyk and Kurmann [7] was adopted to determine citrate in whey through spectrophotometer. For sample preparation, whey samples (2.0 ml) were accurately measured into a 100ml-calibrated flask. 20ml of warm water was added, shaken and 40ml aliquot of TCA (30%m/v) was added to each flask, which was then diluted to mark with water, shaken and left to stand for 45 min. Thereafter, contents were filtered through Whatman NO. 540 paper by discarding the first 10ml.

**Chloride Test:** Chloride content in whey was determined by the Mohr test, using silver nitrate for titration and potassium chromate as an indicator [8].

**Statistical Analysis:** The data obtained was processed and formulated as per the procedure [9]. The Mean± SEM of different minerals were also graphically presented using Graph pad prism 3.02,1999, Graph pad Software Inc., San Diego CA for Mann Whitney test.

## RESULTS AND DISCUSSION

The mean values of composition and physico-chemical properties like pH, acidity, fat protein, lactose total solids and minerals like sodium, potassium, chloride along with calcium, magnesium are presented in Table 1 as mg per litre.

The findings indicated that chemical composition of different whey samples was approximately similar except for market samples where variation may be due to the chemical composition of milk used for the preparation of paneer and cheeses.

The amount of total solids, fat and protein content of cheese whey is more than that of paneer whey. The values were in accordance with the [10] and the variation may be attributed to processing methods. The processing conditions have greater influence over the parameters like protein and total solids. i.e. whey proteins are more susceptible to heat treatment and are denatured at temperature of 70°C and above with the reduction in pH. Hence, the cheese whey contained more protein and paneer whey, whose milk was boiled and then citric acid is added for coagulation, contained less protein.

Table 1: Chemical Composition and Physico-chemical Properties of Paneer and Cheese Whey

| | Whey | |
|---|---|---|
| Contents | Paneer | Cheese |
| Sodium (mg/l) | 350±3.89 | 260±1.78 |
| Potassium (mg/l) | 1300±2.35 | 1300±1.56 |
| Calcium mg/l | 480±1.34 | 291±3.2 |
| Magnesium mg/l | 59±0.18 | 36±0.21 |
| Chloride mg/l | 1349±1.67 | 1167±1.49 |
| Citrate mg/l | 6750±1.67 | 2452±3.67 |
| Zinc µg/L | 280±0.16 | 210±0.21 |
| Total protein% | 0.41±0.07 | 0.53±0.28 |
| Fat% | 0.01±0 | 0.2±0.06 |
| Lactose | 4.5±0.89 | 5.0±0.05 |
| Total solids | 5.8±0.13 | 6.3±0.12 |
| pH | 5.5±0.08 | 6.21±0.08 |

Results are expressed as Mean±S.E, n=3

Lactose is largely removed in the whey during paneer making. Lactose content was higher in cheese whey, which is a limitation of cheese whey as a base for whey beverages against lactose intolerance [11]. The bioavailability of calcium and magnesium in dairy products is considered excellent since intestinal absorption of both elements is facilitated by lactose. Calcium and magnesium content in cheese whey were lesser as compared to paneer whey. During rennet coagulation in cheddar cheese making, calcium is precipitated as a calcium caseinate complex so that most of the calcium is in the curd rather than the whey. During acid precipitation, more highly ionized calcium was produced which leads to higher calcium quantities in paneer whey. This was conceptualized by Wong *et al.* [12] in 1978 and later confirmed by Padmavati *et al*. [13]. Zinc concentration was approximately similar in both paneer and cheese whey (200-280µg/l). It is an important component in cell membrane structure and function as an antioxidant. Chloride content is higher in paneer whey indicating the presence of more salt concentration.

High citrate in paneer whey is generally due to citric acid used during the coagulation. This reason also supports the fact of low pH of paneer whey than cheese whey. Citrate has a longer shelf life and correct acidosis in acute diarrhoea [14].

It was an observation that heat treatment did not influence the chemical composition of the whey. The variation or the standard errors with mean values can also be attributed to the method of dry ashing where improper ashing may sometime lead to loss of minerals.

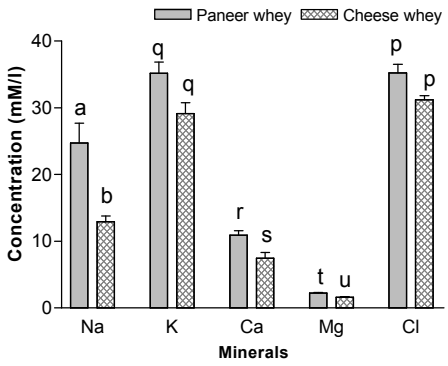


Fig. 1: Significant differences among electrolytes of paneer and cheese whey. Bars with different letters are significantly different

**Significant Comparison for Electrolytes Concentration:** The more or less similarity in observable values for cheese and paneer whey lead to the indistinctness in selecting better whey option for electrolyte drink. For calculating the significant difference, the Mann Whitney U test is applied between the mineral composition (mM/l) of paneer and cheese whey (Fig. 1). It can be interpreted that the concentration of potassium and chloride did not differ significantly between the two types of whey, while the concentration of minerals like sodium, calcium, magnesium differed significantly ($p<0.05$) and was found to be at par in paneer whey.

From the above results, it was concluded that the pH, protein, total solids and lactose contents were higher in cheese whey but minerals like sodium, calcium and magnesium contents were lower in cheese whey compared to paneer whey. For a better electrolytic drink, mineral concentration should be high and lactose concentration should be less [15]. Hence, paneer whey is more suitable for the preparation of whey based beverage or electrolyte drink for the replenishment of the lost minerals.

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