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Development Of An Energy Drink From Sweet Liquid Whey

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Abstract

Sweet Liquid whey accounts for up to 90 percent of the yield during cheese making and it has been considered a waste product. The further processing of sweet whey, such as its disposal in the drains, creates a economical burden to small cheese producers. Considering the ingredients (Lactose, Protein etc.,) present in whey are emphasized with health benefits, unprocessed sweet liquid whey is a real base for an Energy Drink. With the useful components of Lactose and Protein present in the whey, the resulting Energy Drink would make a prominent and successful addition to the growing health based beverage sector. An Energy Drink, liquid whey based beverage system was developed, based on the technological and financial capabilities of a small producer. The product was analyzed based on physical value, microbiological value, and its sensory characteristics. With formulation changes, this whey based beverage could prove its market value and plays a competitive role in today's marketplace.

Keywords: Liquid Whey, Energy Drink, Lactose.

I Introduction

Whey is the yellow, watery liquid that separates from the curd during the cheese making process (Smithers *et al.,* 1996). At one time, this whey was viewed as nothing more than a waste. Cheese producers disposed these whey under drains until tightened environmental regulations made the dumping process illegal and expensive (Frank, 2001). Other disposal methods include the discharge of whey into local waterways, the ocean, or as a component in animal feed (Smithers *et al.,* 1996). Further, some amount of whey has also been used as nutrient-laden soil enrichment in a process called land spreading. As land spreading restrictions and water treatment facility regulations continue to tighten over the next few years, cheese manufacturers will be forced to find alternative methods for disposing of or utilizing whey (Casper *et al.,* 1999). Drying process are available for the conversion of liquid whey into whey protein isolates and concentrates for various of applications, but the amount of energy needed for this conversion alone can upset the small cheese producers. The cost of equipment also is prohibitive. An alternative method for sweet liquid whey disposal is in need.

Whey protein is the collection of globular proteins isolated from whey. The protein in cow's milk is 20% whey protein and 80% casein protein (Jay *et al*., 2014). Whereas the protein in human milk is 60% whey and 40% casein (Luhovyy *et al.,* 2007). The protein fraction in whey constitutes approximately 10% of the total dry amount of solids in sweet liquid whey. This amount of protein is typically a composition of beta-lactoglobulin (~65%), alphalactalbumin (~25%), and bovine serum albumin (~ 8%) and immunoglobulin's (Haug *et al.,* 2007). With independent of its pH, they are soluble in their native form.

Being a by-product of the cheese and also of complex enzyme, sweet whey protein as well as casein sub products are not suitable for consumption by lacto-vegetarians. The amino acid cysteine in whey protein is a substrate for the synthesis of glutathione in the body which is a ubiquitous cellular antioxidant; laboratory

experiments have suggested that whey protein and its components might reduce the risk of exposure to cancer in animals and humans, paving a way for future medical research (Moreno-Indias *et al* ; 2007).

Based on the advantages of whey, it has become one of the popular sources of nutrition in a multiple forms: whey protein bars, whey protein concentrates, whey protein isolates and whey based beverages. According to the survey of International's Global New Products Database (GNPD), 1,832 products in the America and 7,246 worldwide were exposed to whey ingredients in 2005 (Gottschalk, 2006). These products require that the whey can be processed from its native form through drying, ultrafiltration, and or hydrolysis way of treatments. The core of this research was to make use of the unprocessed sweet liquid whey as health based beverage. A broad evaluation of market, the current whey beverage sector shows no evidence of such product.

Whey containing most of the carbohydrate about 20 % of milk protein, water soluble vitamins and minerals (Francis, 2000). Though whey constitutes 40 per cent of the milk solids because of the low concentration of the constituents (about 5.4 to 6.0% dry matter), it has not been usually considered as a by-product but as a waste product (Harper, 2000). The growing menace of environmental pollution and the huge loss of nutritional solids resulting due to gross wastage of whey, stress the need to explore the possibilities of utilization for human use. In this present article we fortify the whey water along with the barley and Green Tea in order to make the whey as a value added product (Pawar, 2004).

II MATERIALS AND METHODS

i) MATERIALS REQUIRED

a) Crude Whey

A crude sample of whey is collected from Milky Mist, Chitode, and Erode District after the cheese making (fig.1)

b) Coagulation agents

Citric acid crystals are procured from precision scientific; Coimbatore. It also can be extracted from fresh lemon.

c) Sugar

Good quality sugar is procured from the local market.

d) Chemicals

Chemicals were used from the Laboratory store in Bannari Amman Institute of Technology, Sathyamangalam.

e) Glass ware

volumetric flasks, Conical flask, beakers, measuring jars, test tubes, bacteriological transfer, pipettes petridishes, dilution bottles, acid measures were used for chemical and microbiological analysis. The glassware's was thoroughly washed with solution followed by rinse in running water and subsequent draining and drying. The glass wares were sterilized using hot air oven at 180° C for half an hour.

f) Equipment Required

pH meter, Spectrophotometer ,Incubator, Autoclave, Electronic balance, Electric oven, Centrifuge, Thermometer

ii) MATERIAL REQUIRED FOR FORMULATION

a) Whey water

Collected from Milky Mist, chitode, Erode District.

b) Barley water

Barley water is prepared by boiling the barley pearls in the water (250 g of pearls in 1000 ml of water).

c) Green Tea Extract

The Green leaves are boiled in water to get the extract (1g of leaves in 10 ml of water).

d) Sugar

Sugar is added to the formulate depending upon the requirement, approximately 20g is added.

e) Sodium Citrate

Sodium citrate (food grade) is added as a stabilizer (0.1g).

f) Formulation

Nutrients	Concentration
Whey Water	70 ml
Barley Water	30 ml
Green Tea	5 ml
Sugar	20g
Sodium Citrate	Little (w/v)

iii) ADDITIVES USED

a) Barley Water

Barley is a cereal plant and belongs to the Gramineae family. Barley water can be prepared by boiling barley pearl, heating it, and then pouring the hot water over the rind. Barley is a good source of dietary fiber and adding it to our daily diet will help as to get the recommended daily dosage of fiber.It contains rich source of phosphorous that is required for cell production and repair in the body. It contains a good amount of copper and is therefore beneficial to people suffering from arthritis and other inflammatory diseases. In Ancient civilizations the barley water was considered to be a good remedy for improving complexion and reducing the signs of aging. Barley is a rich source of vitamins B1, B2, B3, B5, B6, B9, and vitamin E. It contains good source of minerals like calcium, magnesium, iron, selenium, potassium, and zinc. There are a number of nutritional benefits of barley water that help treat and prevent a variety of diseases and disorders.

b) Green Tea

Green tea is unfermented, rich in poly phenol an effective antioxidant. Fortification of Whey-Barley water with 10% of green tea extract did not in any way effect its sensory quality particularly color and flavor. On the other hand addition of green tea extract enhanced the flavor of Whey beverage. Most of the diseases and abnormal conditions of health is attributed to the degenerative effect of free radicals damaging the normal cells functioning leading to diseases like cancer, arthritis, etc;

c) Stabilizer

Various functional ingredients are incorporated in Whey-Barley beverage. Some of them are less soluble and result in little sedimentation. To Sodium citrate (0.1%) was added to Whey-Barley beverage as stabilizer. Addition of stabilizer has increased the viscosity and made the beverage drinkable like any other fruit juices.

Figure 1: Crude Whey Sample (yellow watery liquid)

III EXPERIMENTAL PROCEDURES

i) CHEMICAL ANALYSIS

a) DETERMINATION OF FAT CONTENT

The fat content in the packed whey protein sample was determined by Gerber method as per manual in diary chemistry (1982 reprint) N.D.R.I.The fat present in the whey protein samples made from the milk is in the form of an emulsion. This emulsion in broken with sulphuric acid (Gerber sulphuric acid-sp gr.1.820 at 150c) and the fat separation is facilitated by iso-amyl alcohol.10ml of gerber sulphuric acid was taken into a butyrometer. To this 10.75ml of whey protein and 1ml of iso-amyl alcohol was added. The butyrometer was closed with the stopped, shaken well till all the contents are well mixed. Now the butyrometer was placed in the water bath at 65Cplus or minus 2C for tempering for 3minutes and shaken periodically until the solution of whey protein sample was centrifuged at 1200 rpm for 5 minutes. The percentage of fat the tested sample is read directly from scale by adjusting the fat column within the scale of the butyrometer. This procedure of the fat determination was repeated for different brands of the whey protein samples by conducting 5 trials each (Blaschek *et al*:2007).

b) DETERMINATION OF PROTEIN

The protein content of fortified whey drink was determined by formal titration (pyres method) as per Manual in the Dairy Chemistry (1982) N.D.R.I.The percentage of the protein in the fortified whey drink samples was determined by weighing 10g of the samples accurately and mixing the same with 10ml of water in a mortar and pestle. This mixture was groundwell to make a homogenous liquid. 10ml of the homogenous sample was transferred in a 100ml Erlenmeyer flask. To these 5 drops of phenolphthalein indicator and 0.4ml of saturated potassium oxalate was added and kept aside for 2-4 minutes without disturbing. The whey mixture solution was titrated against 0.1N sodium hydroxide (standard alkali) to its end point. To this titrated solution, 2ml of neutral formalin was added and mixed well. This was titrated against the standard alkali to the same end point as before(Akbache *et al*:2009). The volume of the alkali used in the second titration was recorded. Volume of N/10 sodium hydroxide required by the 10ml sample treated with formaldehyde was recorded as „V ml". The percentage of the protein in the sample is calculated as V x dilution factor x 1.7 (pyne"s constant).The procedure of the protein determination was repaired for different brands of whey samples by conducting 5 trials each.

c) DETERMINATION OF ACIDITY

Titratable acidity of the milk and weight was determined according to IS:1949, Part I (1960). Acidity of the whey drink was determined by measuring 100ml of the sample in a suitable titration flask. To this one

millimeter of phenolphthalein indicator solution (prepared by dissolving 0.5g of phenolphthalein in 100ml of 50 percent ethyl alcohol) was added (Etzel,2004). After thorough mixing by shaking well, it was titrated against 0.1N sodium hydroxide solution used to neutralize 100ml of the whey drink sample.

ii) MICROBIOLOGICAL ANALYSIS

Different whey samples were opened in the laminar flow table sterilized by UV radiations. The Contents were emptied individually on separate wire sieves and were collected individually.

Sampling

Eleven g/ml of the whey sample was weighed aseptically in a sterile beaker and transferred to 89ml of sterile normal saline and rendered into a fine paste using a pre-sterilized pestle and mortar thoroughly in a suitable container. Further, 10 fold serial dilutions were prepared using 9ml sterile normal saline dilution banks for the whey samples separately.Aseptic conditions were maintained during sampling and plating. The procedure for the various viable counts is indicated as follows:

a) DETERMINATION OF TOTAL BACTERIAL COUNT

Composition of Bacteria Media

Ingredients	**g/liter of water**
Peptone	5.0
Yeast Extract	2.0
Dextrose	1.0
Agar	20.0

Media preparation: The above ingredients were soaked for 3 to 5 minutes in cold water, the mixture was boiled above an asbestos-centered wore gauze over a flame. The completely mixed solution was stirred continuously and efficiently to avoid charring. The pH of the solution was adjusted to 7.0 at 50° C with sodium hydroxide solution. This solution was filtered through a cotton pad till clear filtrate is obtained and sterilized in an autoclave at 121°C for 20 minutes. Eleven g/ml of the material from each individual sample, using a sterile pipette was weighed and Suspended in 89ml of dilution water at 45° C. The contents are mixed properly by agitating the mixture. One millimeter of suitable dilutions is added to the sterile petridishes. The agar medium melted in a conical flask and kept at 45° C to 50° C. Now the medium was introduced aseptically at 42° C to 44° C, into petridishes and mixed by rotating and tilting the dishes without spreading over the edges. The mixture was spread evenly over the bottom of the plate and allowed to solidify. The plates are now inverted and incubated at 37° C for 48 hours (Tunick,2000). The colonies were counted with the aid of magnifying lens under the uniform and properly controlled illumination. The bacterial count per gram from the dilutions used in computed and recorded.

b) DETERMINATION OF COLIFORM COUNT

Composition of Coliform Media

Ingredients	g/liter of water
Yeast extract	3.0
Peptone	7.0
Bile salt	1.5
Lactose	10.0
Sodium chloride	5.0
Agar	15.0
Neutral red	0.03
Crystal Violet	0.002

Coliform bacteria include all aerobic and facultative anaerobic gram negative, Non-spore forming bacteria which ferment lactose with the production of acid and gas. Development of dark red colonies at least 0.5mm in diameter in a solid medium (violet red bile agar) within 20 to 24 hours at 35° C may be considered as a positive evidence of the presence of the coliform bacteria (Fox,2009). Violet red bile agar is one the standard media used for the determination of general types of coliform organisms including those of fecal origin in water, milk and other materials of sanitary importance. Coliform counts were enumerated by ALPHA (1978) method using rehydrated violet red bile agar (HI media) of the following composition.

c) DETERMINATION OF YEAST AND MOLD

Composition of Yeast & Mold Media

Ingredients	g/liter of water
Potato extract	100
Dextrose	20
Agar	15
pH	5.6 ± 0.2

The yeast and mold count was determined according to the procedure recommended by American Public Health Association (APHA, 1978) using potato dextrose agar medium (Hi-media). To rehydrate this medium, 39g was suspended in 100ml distilled water and boiled to dissolve the ingredients completely. The medium was sterilized by autoclaving at 121° C for 15 minutes. Just before using the medium for plating, pH of the medium was adjusted to 3.5 by using sterile 10% tartaric acid.

iii) SENSORY EVALUATION

a) HEDONIC RATING TESTING

Taste these samples and check how much you like do or dislike each one. Use the appropriate scale to show your attitude by checking at the point that best describes you're feeling about the sample. Please give a reason for the attitude. Remember you are the only one who can tell what you like. An honest expression of your personal feeling will help us.

Table: Hedonic Table

Judges	Color	Consistency	Sedimentation	Flavor	Taste	Average
A						
B						
C						

Grades: 1 – Excellent, 2 – Very Good. 3 – Good, 4 – Satisfactory, 5 – Bad

IV RESULTS & DISCUSSION

i) Chemical Quality of Whey Water

Whey water was examined for its chemical quality. The results are recorded in TABLE 1.The acidity and pH of raw milk is the normal range of 0.23 to 0.24% & 4.2 to 4.7 respectively. Fat was 0.5 to 0.58%. Protein content was found in the range of 0.75 to 0.78%. All the chemical parameters of whey water meet the standard requirement. Hence whey water is found to be of good quality.

Table 1: Chemical quality of Whey water

Trial No	Acidity	pH	Fat	Protein
1	0.24	4.7	0.52	0.76
2	0.23	4.2	0.58	0.72
3	0.24	4.6	0.53	0.78

ii) Bacteriological quality of Whey water

Whey water was subjected to bacteriological analysis and the results attached are shown in TABLE 2.The total bacterial count is found in the range of 360 to 580x10^1 cfu/ml. All the bacterial counts of whey water are found to be on the lower side. Hence the quality of whey beverage is considered to be unsatisfactory.

Table 2: Bacteriological quality of Whey water

Sample	Total Bacterial Count * 10^1 Cfu/ml
1	580
2	360
3	450

iii) Chemical Quantity of Fortified whey and barley drink.

The Whey beverage was examined for its chemical quality. The results are recorded in TABLE 3. The acidity and pH of raw milk is the normal range of 0.18 to 0.21% & 6.3 to 6.66 respectively. Fat was 0.4 to 0.51%. Protein content was found in the range of 0.1 to 0.2%. All the chemical parameters of whey beverage meet the standard requirement. Hence whey water is found to be of good quality.

Table 3: Chemical quality of Fortified whey and barley drink

%Barley	Acidity %	pH	Fat %	Protein %
10%	0.18	6.3	0.45	0.1
20%	0.21	6.5	0.51	0.2
30%	0.19	6.66	0.42	0.12

iv) Microbiological Quality of Fortified Whey Water.

The low calorie whey beverage fortified with Barley was subjected to microbiological analysis and the results obtained are attached are shown in TABLE 4. The total bacterial count is found in the range of 250 to 480x10^1 cfu/ml. The coliform and yeast mold count is found in the range of 260 to 390 cfu/ml and 220 to 340 cfu/ml respectively. Hence the low calorie whey beverage is found to be good with respect to its bacteriological quality as the bacterial population is less than 80,000 per ml. The beverage therefore is considered safe for consumption.

Table 4: Microbiological Quality of Fortified Whey Water

% Barley	Total bacterial Count*10^1cfu/ml	Coliform Count Cfu/ml	Yeast and mold Cfu/ml
10	480	260	340
20	250	390	220
30	360	280	310

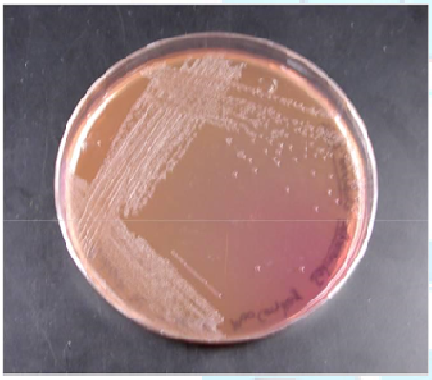

Figure 2: Coliform Count

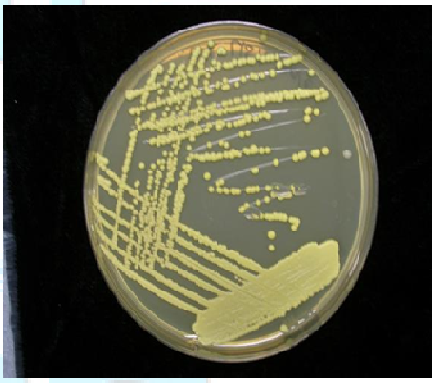

Figure 3: Bacterial Count

iv) Sensory Evaluation of Whey Drink

a) Hedonic Rating Test

The processed solution was subjected to sensory evaluation by different set of peoples and the average was taken. Overall average is found to be **3.12** Out of 5.

Table 5: Sensory Evaluation of 70% whey along with 30% Barley fortified with Green Tea

Judges	Color	Consistency	Sedimentation	Flavor	Taste	Average
A	**3**	**4**	**3**	**3**	**4**	**3.4**
B	**4**	**2**	**3**	**2**	**3**	**2.8**
C	**2**	**3**	**4**	**3**	**4**	**3.2**

Discussion

Whey is highly a nutritious product that contains about 0.6% of protein. Whey concentrates are considered to be one of the most prominent nutrition then other components. It has been said that the adult daily requirement of amino acids can be furnished by 14.5g of lac albumin, whereas it requires 17.4g of whole egg precipitation and 28.4g of cow's milk precipitation (Smither, 2008). Whey are rich in B group vitamins.whatever methods are carried to examine whey components; it gives extremely a high score for whey nutrition's. Here, the whey drink is developed based on the properties of Barley and the green tea. Both ads supplement nutrition to the whey product. Inclusion of 30% barley in 70% of whey along with the small quantity of green tea gives the more immense energy drink(Larsen *et al*;2010).

This fortified Whey drink will act as a low cost refreshing energy drink containing all nutritional supplements that human required for day-to-day life (Bernard *et al*;2011). Hence, this drink would solve the problem based by many diary industries to dispose the whey into a value added product.

Conclusion

A whey based beverage system was developed and prepared as an alternative solution to both ground disposal and expensive drying of liquid whey (Ben *et al*; 2010). The results suggest that the feasibility of such a system, although challenges remain. Other factors that may be of interest in continued studies include evaluation of shelf stability, variation in flavors and colors, effective use of hydrocolloids for particle suspension, and alternative post-processing pasteurization techniques. But the drink is nourished with the health vale with the help of barley and green tea (pasin *et al*; 2000) .Both give energy to the body when the supplements needed.This low cost drink would be effective if it is processed in large scale sector.

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