



An Overview on Whey Based Herbal Beverages

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Abstract: *Whey is the largest by-product of the dairy industry both in terms of volume and milk solids as it contains 50% of original milk solids including whey protein, lactose, water soluble vitamins, residual lipids (fat) and minerals. It is a value-added functional beverage formulated by using unprocessed liquid whey. Now-a-days it is considered as nutritional powerhouse of future. and used as energy-based drinks for therapeutic applications and for sportsman in many countries. Ready-to-drink beverages offer the advantages of portability and convenience of today's busy consumers because of their excellent nutritional qualities, ease of digestibility and unique functionality in beverage systems. The functional properties of whey-based products can be improved by initiating herbal ingredients to their compositions. Fruits and vegetables are the important source of nutrition and highly recommended in daily diet for healthy living. Blending of fruits and vegetables juice in traditional juices can be beneficial for improving the nutritional quality of the traditional herbal beverages. This review is based on the latest trends in the creation of functional whey-based beverages enriched with herbal ingredients. The tremendous growth and development in the beverage market makes it very competitive field for the tradition beverages.*

Key Words: *Nutrition, Ready to serve, Herbal beverage, Whey protein, whey-based beverages, Fruit and vegetable beverages.*

1. INTRODUCTION:

The need for healthy and nutritious foods is growing every day as modern consumers become more aware of the importance of eating healthy, safe, and nutritious foods. Because today's customers are more health-conscious, the demand for functional foods is steadily expanding. People currently pay more attention to the nutritional makeup of food and beverages than to their taste. Whey-based beverages continue to garner a lot of attention these days. These show that consumers and manufacturers alike are becoming more aware of the huge potential these offer for expanding product profiles. As a result, converting whey into drink is one of the most cost-effective ways to use whey [1]. Commercial sport drinks, health drinks, fermented whey drinks and flavoured non fermented whey beverages are available in the market [2]. In many cases, whey-based beverages are inevitably prepared using synthetic food flavour agents and colorants to mask the unacceptable whey flavour. Increasing awareness on consumption of foods and beverages with functional properties and its positive impact on human health has led to investigate upon the development of whey-based beverages [3].

Beverage needs to be cost effective convenient, nutritious and palatable to satisfy the modern consumers as well to compete in the beverage market. Besides all these factors various research evidences have proved that functional whey beverages have potential to be utilized in various forms and can be alternate healthy source of nutrition in daily diet when compared to other thirst-quenchers. The other hand, incorporation of different fruits and vegetables should be encouraged as well as the production should be done in large scale as they are very beneficial source of nutrition [4]. Convenient nature and efficient of beverages are one of the factors driving the growth of beverage market.

This paper investigates the current literature regarding the nutritional composition of whey protein and also about the impact of whey -based beverages in human health and hence encourages the development of whey-based beverages so that they can be used as an alternative source of nutrition in daily diet.

2. WHEY PROTEIN:

A semi- translucent liquid generally greenish yellow in colour widely known as milk plasma or whey which often gets separated out during the cheese making process [5]. Whey is a major by-product of dairy industry due to its



High Biological Oxygen Demand Value (BOD) which ranges between 39,000 to 48,000 ppm [6]. Whey and milk are used as a base for feed products with complex content that are produced in two ways:

1. by including plant materials into milk and whey, and
2. by additon of dairy ingredients to plant materials.

The functional properties of whey-based products can be improved by introducing herbal ingredients into their composition. This combination regulates the content of vitamins, carbohydrates, minerals and dietary fiber in foods.

In past 20 years, recent research made whey a co-product and as a functional food with many nutritional applications. Whey based products such as whey drinks and concentrates stability concerns during storage. Its stability effects during different storage temperatures.

A. Whey: A Source of Functional Beverage:

Whey is a type of protein found in milk that contains all the essential amino acids (EAA) needed for muscle growth and repair. Dairy products, particularly milk, are the best “whole food” sources of whey protein. Whey protein can be extracted from milk during the cheese-making process [7] and concentrated into a powder. Whey protein powders can be sold as conventional foods or as dietary supplements and are often added to other food and supplement products, including gels, powders, sports/energy bars, and ready-to-drink shakes.

Although whey was first considered to be a waste product and eliminated, it is now utilized as food products and food ingredients, such as whey-protein based ingredients rather than wasting and treating as by-product.

3. COMPOSITION OF WHEY:

The components of whey include alpha- lactoglobulin, beta-lactoalbumin, bovine serum albumin, Glycomacropetides, lactose, lactoferrin, Immunoglobulins, lactoperoxidase enzymes, and some minerals. When the nutrients in whey is concerned cheese, it contains about 50% of milk solids, including almost 100% of the lactose and 20% of the total protein [8]. The primary components of whey protein with their benefits are listed in the table 1.1.

Table 1.1 - Primary Components of Whey

Whey Composition	% Of Whey Protein	Benefits of Whey	Reference
Beta-lactoglobulin	55-55%	Excellent source of essential and branched amino acids with binds fat soluble vitamins, increases bioavailability.	[9]
Alpha-lactoglobulin	20-25%	Primary protein in breast feed milk. High in essential amino acid tryptophan, which helps in regulating sleep and stress control.	[10] [11]
Immunoglobulin	10-15%	IgA, IgD, IgE, IgG – Primarily IgG. Primary protein found in colostrum. Benefits to all ages, maturity, particularly infants	[11] [12]
Lactoferrin	1-2%	An antioxidant found in breast milk, saliv, tears and blood. Promotes beneficial bacteria, antiviral, antimicrobial, regulation of bioavailability	[9] [11] [13]
Bovine Serum albumin	5-10%	Fat building properties in body	[9]

4. WORLDWIDE DISTRIBUTION OF WHEY PROTEIN:

The whey protein powder market is broadly segmented into Europe, North America, Asia Pacific (APAC), South America (SAM), the Middle East & Africa (MEA). In 2018, Europe held the largest share of the global whey protein powder market, followed by North America.

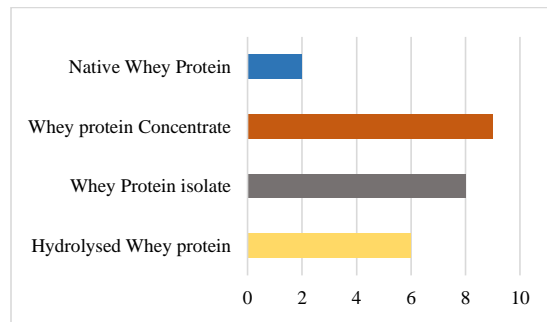
The demand for whey protein is forecasted to rise due to growing investment in research and development by manufacturers along with the applications such as food and beverages, pharmaceuticals, and others.



A. By-Product Type:

The global whey protein market has been segmented on the basis of product types into hydrolyzed whey protein, whey protein concentrate, whey protein isolates and native whey protein. Of these, WPC with a revenue of USD 3731.65 million in 2018 commands the largest market share in the whey protein market globally and is anticipated to earn revenue to the tune of USD 5536.92 million by end of 2024 while growing at a CAGR of 6.91% over the forecast period.

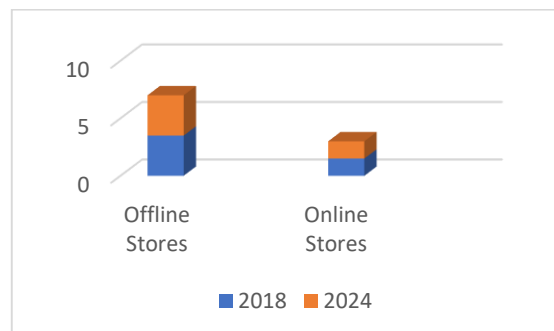
Chart – 1: Global Whey Protein Market Share (%), By Product Type-2018



B. By-Distribution Channel:

The global whey protein market has been segmented on the basis of distribution channel into offline and online stores. The online segment is expected to attain market share of 27.79% by the end of 2024. Based on distribution channel, worldwide whey protein powder market can be additionally sectioned into immediate and roundabout.

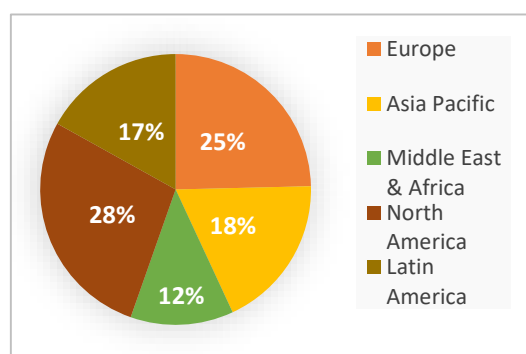
Chart – 2: Global Whey Protein Market Share (%), By Distribution Channel-2018 & 2024



C. Regional Growth Highlights During 2020 – 2024

On a geographical front, the European Union enjoys the leading position in the global whey protein market. This can be attributed to the rising awareness about the health benefits of whey protein intake by fitness enthusiasts which has amplified the memberships at gyms and fitness training centres amongst the populace of the region.

Chart – 3: Global Whey Protein Market Share (%), By-Region-2024





D. Application Insights:

The F&B market segment led the whey protein market and accounted for more than 48.0% share of the global revenue in 2019. The product is preferred for baked goods and confectionery products due to its ability to emulsify, brown, foam, and thicken products. These ingredients also show a positive impact on solubility, nutritional fortification, gelation, and water-binding properties of baked goods.

5. RECENT RESEARCH IN WHEY:

Research evidences supporting the Nutritional quality of vegetables and fruits whey protein, therefore the utilization of whey protein in Ready to Drink Beverages is highly encouraged.

Lactoferrin is an iron binding minor glycoprotein present in bovine milk. It has been determined that Bovine whey and individual whey protein exhibit antioxidant activity. This bioactivity is observed with different commercial whey products (WPI and WPC) is resistant to processing method, and is increased by enzymatic hydrolysis.

6. TYPES OF WHEY:

Whey proteins are available in different forms namely whey protein concentrates (WPC) and isolates (WPI), whey protein fractions (α -lactalbumin and β -lactoglobulin rich fractions, casein Glycomacropetides, lactoferrin, and lactoperoxidase) and protein hydrolysates (WPH) in the market (Table 1). Whey can be classified into two categories as per the production process as acidic whey (pH < 5), and sweet whey (pH 6 and pH 7) [14].

1. WPC34: Whey Protein Concentrate 34%; WPC80: Whey Protein Concentrate 80%;
2. WPC90: Whey Protein Concentrate 90%; WPI: Whey Protein Isolate.

Table -2: Types of Whey

Whey Product	Fat (% by Weight)	Lactose (% by Weight)	Protein Concentration (% by Weight)	Application
Whey Powder	1-1.5%	63-75%	11-14.5%	Production takes place by taking whey directly from cheese production, clarifying, pasteurizing and drying. Used in bakery, bread and dairy foods.
Whey Protein Concentration (WPC)	1-9%	4-52%	25-89%	Common and affordable form of whey. Used in chocolate bars, confectionery, beverages, nutritional sport food manufacturing.
Whey Protein Isolates (WPI)	0-1.5%	0.5-1%	90-95%	Use in bakery, protein bars and protein supplement products and nutritional food products manufacturing.

7. WHEY PROTEIN ROLE IN BODY COMPOSITION:

Whey having high concentration of EAAs and BCAAs, has been shown to help for maintaining muscle tissues. It is

- Anti-Cancer
- Anti-Diabetics

Also act as fat substitutes and emulsifiers but exhibit smaller particle sizes [15].



8. HERBAL BEVERAGES:

Herbal beverages when consumed within a balanced diet, may improve the antioxidant status, and reduce oxidative stress in humans. In addition, many commonly consumed herbal beverages does not contain any detectable caffeine levels as in coffee and tea.

The commonly used tea is a beverage made from leaves and buds or twigs of the plant *Camellia sinensis*, and is only second to water, the most consumed beverage in the world. The term herbal beverage/tea usually refers to infusions with fruit or other herbs that do not contain *Camellia sinensis*. Herbal beverages when consumed within a balanced. They are also called tisane, herbal infusion, or botanical infusion to avoid confusion with true teas.

Herbal beverages can be made with fresh or dried flowers, leaves, immature fruits, seeds, and/or roots by steeping (infusion) or boiling (decoction) of the source materials including herbs.

Selected examples of herbal beverages commonly used by populations across the globe to boost optimum health as well as for reducing the risk of a number of disease conditions such as hyperglycaemia, dyslipidaemia, and hypercholesterolemia, cancer represented in table 3.

Table -3: Selected Herbal Beverages commonly used are

Local Name	Scientific Name	Family	Parts
Ginger	<i>Zingiber officinale</i>	Zingiberaceae	Rhizomes
Chamomile	<i>Matricaria chamomilla</i>	Asteraceae	Dried flowers
Peppermint Tea	<i>Mentha piperita</i>	Lamiaceae	Dried Leaves
Corriandum	<i>Corriandum sativum</i>	Apiaceae	Dried flowers
Beli, Bael, Bengal quince	<i>Aegle marmelos</i>	Rutaceae	Dried leaves, buds, flowers, immature fruits, bark.

9. WHEY BEVERAGES TYPES AND THEIR INGREDIENTS:

Four basic types of whey beverages were identified [16]:

1. Mixtures of whey (processed or unprocessed) with fruit or (rarely) vegetable juices;
2. Dairy-type, 'thick' beverages (fermented or unfermented);
3. Thirst-quenching carbonated beverages (the 'Rivella -type'); and
4. Alcoholic beverages (wine, beer, liqueurs).

A. Dairy-Type Whey Beverages:

In contrast to whey beverages resembling fruit juices, the use of whey or its components in a drinkable yogurt or similar dairy-type beverage is less straightforward. There are two basic types of dairy beverages:

1. Unfermented milk and milk derivatives, flavoured Milk, milk shakes and similar products (based on skim, or partially skimmed, full-fat or even fat-enriched products); and
2. Fermented products such as buttermilk, sour milk, kefir and other cultured dairy beverages. The main difference is the pH which is to the neutral range (pH 6.2–6.5) in the former, while most fermented dairy products and acid whey are quite acidic, with the pH of 4.8–4.5 [17].



Table -4

Nutritional Ingredient	Dry Sweet Whey	Value per 100gm of Edible Protein				
		WPC34	WPC80	WPC90	WPI	WPI Hydrolysed
Water	3.19	3.93	4.11	4	4.50	4.50
Energy	353	369	412	400	360	360
Protein	12.98	34.36	80	90	90	90
Carbohydrate	74.46	50.80	5.31	6	0.87	0.50
Total Lipids (Fats)	1.07	3.93	6.60	6.25	0.50	0.50
Ash	8.35	6.99	3.98	3.75	3.38	4.50
Minerals						
Calcium, Ca	769	569	423	400	600	200
Iron, Fe	0.88	0.89	1.20	0	5	5
Magnesium, Mg	176	104	50	50	15	10
Phosphorus, P	932	574	0	325	25	30
Potassium, K	2080	1680	517	0	0	800

B. Utilization of Whey in Different Fruit Beverages:

In past few years there are various whey-based fruit beverages which are developed successfully and also found to have the necessary acceptability. Different types of fruit pulps or fruit juices are used for the development of beverages. The beverages can contain carbohydrates, protein, vitamins, mineral and sometimes with added ingredients they are also supplemented with dietary fibers. The addition of different types of fruits, berries and sometime vegetable juice, the beverage plays a role of breakfast beverages, snack type beverages or also a drink with healthy image having essential vitamins.

Apart from being delicious, strawberries are equally beneficial for health. They are rich in various phenolic compounds and many bioactive phytochemicals such as flavonols, catechins, anthocyanin and proanthocyanidins. They are gaining attention due to their antioxidant and their important role in prevention of chronic diseases and other putative role in diseases like cancer and heart diseases [18].

Another best example of whey-based drink which was flavoured by strawberry concentrate which was also fortified with ferrous bisglycinate. The research came up with conclusion that long term consumption of this drink showed a significant impact on the reduction in the pervasiveness of anemia in adolescents.

Watermelon is cheap as well as nutritious fruit which is also available throughout the year and has natural source of lycopene which is also responsible for the red colour [19]. Lycopene is associated with reduced incidence of some types of cancer as well as coronary heart disease [20].

Similarly, whey protein is also utilized with different other fruit and herbal extracts like carbonated whey beverage using orange juice was developed, utilization of whey was done in development of orange- whey beverage, pear- whey beverage, peach- whey beverage, apple- whey beverage [21], banana-whey beverage [22], and pineapple-bottle guard whey mixed herbal beverage [23].

C. Utilization of Whey in Vegetable Beverages:

According to United States Department of Agriculture incorporation of vegetable in our daily diet is always considered as a part of healthy living, people who consume vegetables as a part of healthy diet are less likely to have a risk of some chronic diseases because it contains no cholesterol and are naturally low in fat and calories.

Whey is also utilized with some vegetables for the development of beverages. A whey based herbal beverage was developed with Carrot, beetroot, mint and ginger [24].



Green leafy vegetable has always gained attention due to their high nutritional quantities and its nutritional properties are always greater than other foods. Similarly tones of minerals, vitamins and others nutrients are found in cooked spinach. Spinach contains Vitamin A, K, C, E, B1, B6, B3 and B2 and also contains varieties of Minerals like Phosphorous, Calcium, Iron, Zinc and Selenium [25]. A nutrient rich whey-based spinach beverage was developed using fresh spinach juice and whey [26].

D. Whey Based Thirst-Quenching Carbonated Beverages:

Now-a-days some authors have suggested the addition of carbon dioxide combined with fruit added in it to overcome the undesirable flavour and odour of cooked milk [27]. The most typical product representing this kind of whey beverage is the Swiss ‘Rivella’. It is a sparkling, crystal clear infusion of alpine herbs, first, appeared in Switzerland in 1952 [28]. The finished beverage contained 0.125% total nitrogen 9.7% total solid, and the pH was about 3.7 [29]. Other beverages that have received attention include Bodrost, an alcoholic beer-like beverage made in Russia from pasteurized, clarified whey with the addition of sugar and raisins [30]. Tai made from Brazil is a soft drink fortified with a WPC to contain 1.5% protein [31].

10. GLOBAL BEVERAGE DISTRIBUTION:

The global beverage industry is valued at USD 1813 billion for 2022 and the industry is growing at a CAGR of 4%. It’s value estimations are USD 1885 billion in the year 2023. The beverage industry will further expand and be valued at USD 1961.24 billion in 2024.

A. The market size of the Non-alcoholic beverage industry:

The global non-alcoholic beverage market size is valued at USD 1337 billion in 2022. The market is anticipated to grow at an estimated CAGR of 5.5%. The largest segment of the non-alcoholic beverage market is soft drinks which is estimated to be 201,103 million dollars in 2020.

B. Market size of the alcoholic beverage market:

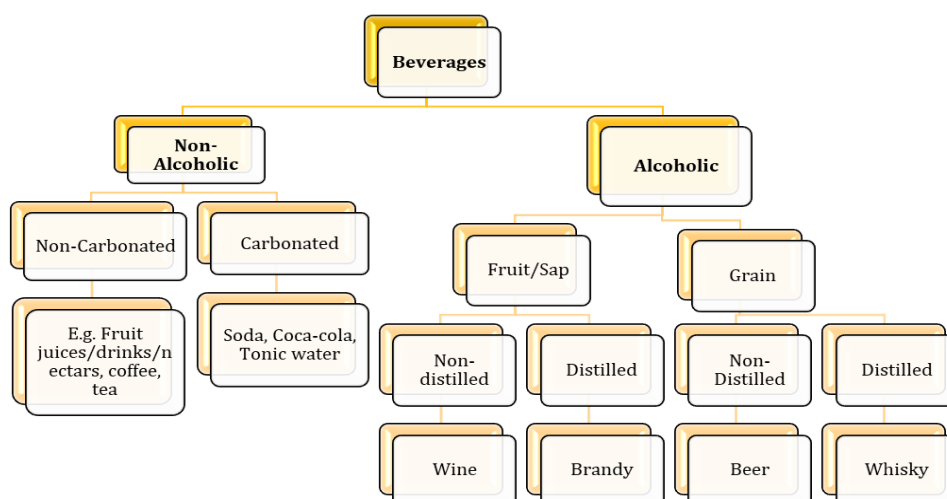
The global alcoholic beverage market share was valued at USD 1559 billion in 2022. The market is expected to grow at a CAGR of 2%. The increase in the trend of drinking in a social gathering is one of the main factors that is driving growth for alcoholic beverage market. While beer and spirits are mostly consumed categories, consumption of wine and premium alcoholic beverages is becoming popular in recent times.

11. TYPES OF BEVERAGES:

Beverages may be further classified into two types:

- Alcoholic beverage
- Non-alcoholic beverage

Fig -1: Types of Beverages





12. APPLICATION OF HERBAL BEVERAGES:

Herbal beverages, consumed as part of a balanced diet, may improve the antioxidant level and enhance the overall health status. Herbal beverages or tea are rich sources of natural bioactive compounds such as flavonoids, carotenoids, polyacetylenes, phenolic acids, alkaloids, coumarins, saponins and terpenoids, among others. A wealth of an available evidence shows that natural bioactive compounds render a number of diversified biological effects, such as anti-inflammatory, antioxidant, antiviral, antibacterial, antiallergic, antithrombotic and vasodilatory actions, as well as anticarcinogenicity, antimutagenicity and antiaging effects.

13. NEED FOR THE DEVELOPMENT OF WHEY BASED BEVERAGES:

Whey beverages are manufactured and formulated keeping in consideration the nutritional values, biological and functional properties. Using a cheese whey as a beverage in nutrition for therapeutic purposes can be traced back to the ancient Greeks; Hippocrates in 460 B.C. The market is driven by five key factor groupings: increased concentration in the global beverages market; diverging functional beverage trends worldwide; product differentiation; flavour innovations; and cross-category innovations.

14. CONCLUSION:

Whey protein is a reliable source of amino acids and biologically active proteins which act as a nutritional supplement. There is growing evidence states that whey protein possesses therapeutic properties in different pathological conditions. For a beverage to be accepted by the modern consumers, it must satisfy at least some of the main determinants of success—desirable sensory quality, thirst-quenching effectiveness, favourable price and positive ‘health image’. With the peculiarities of the whey flavour interfering with many flavouring ingredients and the processing costs adding to the rapidly rising value of the formerly bothersome waste, the future of the whey beverages might lie mainly in the last attribute, the special nutraceutical qualities some of the whey components. Consumer features like convenience, practicability, flavour, nutritional value, variants are generally affecting the market size of the functional drinks. As far as milk is concerned, it is now steadily becoming a functional drink in its various forms like drinkable yoghurt, flavoured milk and others and a vital role will be played by whey-based drinks. Whey and whey-based products can be used to formulate different beverages with multiple application and functionalities.

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