TYPES OF WHEY PROTEIN POWDER. PROCESSING OF DAIRY PRODUCTS AND RESEARCH ON THE COMPOSITION OF PROBIOTIC FERMENTED DRINKS BASED ON ACID WHEY

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Annotation: Whey is a very useful product. The amount of whey created depends on the amount of cheese production, as well as the fertility depending on the type of milk, and about 9 L of whey is obtained for every 1 kg of cheese produced. The main problem lies in the high organic load, mainly due to the high content of lactose, but also the appearance of proteins that are difficult to biodegrade. More precisely, the chemical oxygen demand (COD) of cheese whey can vary from 50,000 to 80,000 mg / l, while the biochemical oxygen demand (BOD) ranges from 40,000 to 60,000 mg / l. The rapid consumption of oxygen in the soil as a result of the breakdown of proteins and sugars present in whey, in accordance with the large volume generated, presents the problem of large amounts of elimination. In this context, the production of lactic acid, ethanol, microbial lipids, microbial biomass, single-cell protein, Poly-hydroxyalkanoates, enzymes and endo-polysaccharidesAnimal protein has the most complete amino acid profile. Then this whey is usually more nutritious than casein. The isolate contains more protein, the hydrolyzate is absorbed the fastest, and the concentrate is healthier. Note that cold-filtered process and grass-fed whey concentrate are optimal for overall health.

Key words: Statistics data, milk whey, cheese, properties, milk processing, fermented drinks, ***whey isolate, whey hydrolysate, whey concentrate.***

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The main by-product of the dairy industry is whey from the production of cheese or casein. Since almost a third of the total milk production is spent on cheese production, and whey in the preparation of cheese is 85-90% of the volume of milk, a large amount of whey is produced - about 19 × 10 6 t per year). Whey is a yellow-green liquid that contains about 50% milk solids, including lactose, whey proteins, and mineral compounds. The fat content of whey is low, and the amount of casein that forms cheese cottage cheese is negligible. The total solid content in whey is about 6.7% [1]. There are currently 3 different kinds of whey protein powder on the market: ***isolate, concentrate and hydrolysate***. Each one is processed differently and their nutritional content varies. Concentrate and isolate tend to be the most popular on the market. All come, however, with their advantages and disadvantages.

Whey Isolate

Once processed, whey is usually broken down into two forms: (Smithers, 2008)

- Concentrate: typically comprises of around 80% protein
- Isolate: typically comprises around 85 – 90% protein

Isolate undergoes additional processing and purification. It minimises extraneous carbohydrate and fats. In order to maximise the protein content. It results that, isolate has a higher protein content than concentrate. However, it contains less naturally occurring benefits in terms of macro- and micro-nutrients. Indeed, they are destroyed in the last process.

Whey hydrolysate

Whey protein hydrolysate can either be a concentrate or isolate. Nonetheless some of the amino bonds have been broken by exposure of the proteins to heat, acids or enzymes.The advantage is that it is more quickly absorbed in the stomach. Indeed, you get the quickest protein absorption due to the hydrolyzation, which almost acts as a pre-digestion process. This generally means faster recovery rate for your muscles. However, hydrolysate generally doesn't contain all the naturally occurring benefits that concentrate may offer. Especially if whey concentrate is cold filtration processed and grass-fed. Besides, despite its high price, hydrolysate generally tastes bad.

Whey concentrate

It is generally cheaper and easier to find as it is quite popular for some good reasons! As it goes through less processes, relatively to others protein powders, concentrate is the healthier. Indeed, it contains the naturally occurring macro- and micro-nutrients derived from the manufacturing process. It is also the most calorie dense form of supplement. Isolate whey may have higher protein percentage, concentrate is healthier. Because, it has nutritional benefits that go beyond better muscle recovery.

The cold filtration processed and grass-fed whey concentrate

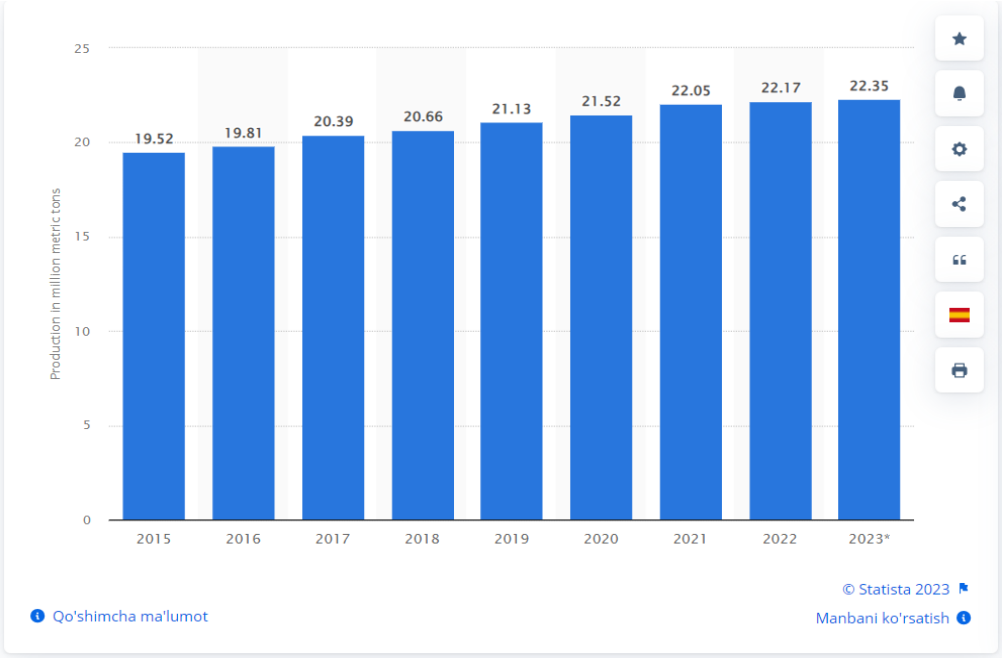
This form of concentrate is really hard to find and serves as a reference in terms of nutritional profile. Indeed, if grass fed and cold pressed, whey concentrate can be especially healthy. Heat can often kill all the micronutrients (ie. the powerful antioxidants) and be more damaging to the proteins hence cold pressed whey is ideal. Additionally, it's easy to assume that most cows eat a grass-fed diet. However, that is not the case – most cows are fed a grain rich diet (generally with fertilizers and GMO) and are given antibiotics to grow faster and bigger. This unfortunately affects the quality! Whereas grass-fed farming is more sustainable and generally more ethical. This method ensure that the cows produce a better whey in terms of quality, nutrient profile and taste Protelicious is just that – cold filtration processed and grass-fed whey concentrate that has nothing to hide and goes above and beyond simply helping in muscle recovery and tasting good.[19].

A few decades ago, whey was a serious problem in the dairy industry, when it was poured into wastewater, causing a major environmental problem, due to the biological need for oxygen due to its high content. Whey makes up about 94% of the water. This is probably the main difficulty, storage, transportation and storage of whey.

- About 0.5% of heat can be recovered with precipitates
- About 0.6% of the moment can be concentrated by ultrafiltration
- Lactose: 4.8%
- Total solids: about 6 hours%
- Whey is a highly diluted solution. There are two types of whey, depending on what type of cheese is obtained:
- Acidic whey with a pH of <5.0 obtained by processing acidic cheeses such as cottage cheese, cream cheese, oat quark
- High mineral content
- Difficult to process; limited use of
- Sweet whey with a pH of > 5.0 obtained from most sweet coagulation varieties of coffee
- Use in Canada is about 100%
- Heating necessary for inactivation of cultures and coagulation enzymes.

Depending on the type of milk clotting, 2 types of whey are distinguished: sweetened whey, which remains after enzymatic milk clotting, and acidic whey, which is a byproduct of milk coagulation by acidification [2]. The presence of lactic acid, a clearly low pH and a high concentration of minerals are less suitable for processing acid whey than its sweetened equivalent, the management of which is especially problematic for the small dairy industry. It performs functions such as antimicrobial, immune-stimulating and anticancer properties, lowering blood pressure and reducing the risk of cardiovascular disease and osteoporosis, and regulating satiety. Since it is liquid, it seems natural to use it as a raw material for the production of unfermented and fermented drinks. The components of whey not only stimulate the growth and survival of probiotic bacteria, but also of lactic acid bacteria in the gastrointestinal tract. To improve texture properties, whey can be combined with fresh milk, condensed milk or milk powder. We conducted this study to assess the possibility of obtaining high-quality probiotic drinks using acidic whey. For this purpose, we evaluated the physicochemical and sensory properties of fermented drinks based on acidic whey, combined with milk, condensed milk or skim milk powder and containing Lactobacillus acidophilus LA-5 or Bifidobacterium animalis ssp. lactis BB-12. We evaluated the quality of the product for more than 3 weeks under refrigeration conditions. The yield of cheese is usually 10-15%, which means that 85-90% of the milk processed into cheese is whey produced in cheese production. Global cheese production in 2022 was approximately 22.35 million tonnes. The European Union is

the largest cheese producer in the world, with an estimated 10.55 million tons of pi that year.



Annual cheese production worldwide from 2015 to 2023 [3]

As a by - product of the production of hard, semi-hard or soft cheese and shirdon casein, whey is known as sweet whey and has a pH of 5.9-6.6. The production of mineral acid precipitate casein gives an acidic serum with a pH of 4.3 - 4.6. Table 1 shows the approximate composition of whey from the production of cheese and casein.

1.table

Approximate composition of separated serum, %

Cheese whey **HCI acid casein serum**

	Cheese whey	HCI acid casein serum
Composition	%	%
Total solids	6.0	6.4
Water	94	93.6
Fat	0,05	0,05
Real protein	0,60	0,60
NPN (non-	0,20	0,20

	Cheese whey	HCI acid casein serum
protein nitrogen		
Lactose	4.5	4.6
Ash (minerals	0,5	0,8
Calcium	0,035	0,12
Phosphorus	0,040	0,065
Sodium	0,045	0,050
Potassium	0,14	0,16
Chloride	0,09	0,11
Lactic acid	0,05	0,05

Cheese whey is one of the most polluting by-products in the food industry due to its high organic load. Under the conditions of a circular economy, it is envisaged to reintroduce products of high added value into the food supply chain, through which to increase stability and create “zero waste” processes.

The amount of whey created depends on the amount of cheese production, as well as productivity depending on the type of milk, and about 9 L of whey is obtained for every 1 kg of cheese produced [4,5]. The main problem lies in the high organic load, mainly due to the high content of lactose, but also due to the appearance of proteins that are difficult to biodegrade [6]. More precisely, the chemical oxygen demand (COD) of cheese whey can vary from 50,000 to 80,000 mg / l, while the biochemical oxygen demand (BOD) ranges from 40,000 to 60,000 mg / l . The rapid consumption of oxygen in the soil as a result of the breakdown of proteins and sugars present in whey, in accordance with the large volume generated, presents the problem of large amounts of elimination. In this context, the production of lactic acid, ethanol, microbial lipids, microbial biomass, single-cell protein, Poly-hydroxyalkanoates, enzymes and endo-polysaccharides in whey Lacto.

There are two fundamentally different products made from whey and called whey cheese: [13]

• Albumin is formed by the heat and possibly acid coagulation of albumin in cheese, whey : ricotta , mizithra, etc.

• Norwegian Brown cheeses are made by boiling whey to concentrate sugar and consist mainly of caramelized milk sugar: mysost and the like. Since they are not composed mainly of coagulated milk proteins, they are technically not cheese [14] [15] two different methods are used to produce cheese whey:

• Whey can be concentrated and then molded. Cheeses produced by this method have a relatively high lactose content. As a rule, they are yellowish-brown in color and have a sweet, baked or caramelized taste.

• Heat can be used to coagulate whey and optionally add acid. This type has a relatively low lactose content and a white to yellowish color. Whey cheesecake made by the coagulation method

In both methods, the serum can be pre-concentrated before further concentration or coagulation. The procedure may also include the addition of raw materials of milk, cream or other dairy origin before or after concentration or coagulation [16] depending on the production method used, whey cheeses range from soft to hard consistency [17] new soft varieties contain a lot of moisture and end quickly. Ripe hard varieties have a much lower moisture level, allowing them to be stored longer. The yield of cheese whey is usually lower than that of regular cheese, as whey does not have the same nutrients as milk. The yield depends on the composition of the whey, the addition of milk or cream, the production technology and the composition of the final product (the amount of moisture). With effective modern methods such as ultrafiltration, whey can be mixed with cream and reduced [18].

The purpose of this study was to assess the quality of fermented drinks prepared using acidic whey. In the production of drinks, we used probiotic cultures of Lactobacillus acidophilus LA-5 or Bifidobacterium animalis ssp. lactisbb-12. The production process involves combining pasteurized acid whey with UHT milk, unsweetened condensed milk or skim milk powder. We introduced milk to enrich the casein content and obtain a product with properties similar to those of fermented milk drinks. Products are stored in the Refrigerator (5 ± 1°C) for 21 days.

During storage, we evaluated the physicochemical and organoleptic properties of drinks. The properties of drinks depended on their composition, microbial culture and shelf life. L. drinks containing acidophilus have a high acidity, which increased during storage; B. acidity of samples containing animalis. Quark cheese is made from approximately 0.8% fatty pasteurized cow's milk and coagulated by acidification using the initial culture of lactic acid bacteria.

The resulting whey was cooled to 5 ± 2°C, transported to the laboratory and used for the production of drinks. Drinks were prepared on the day of the production of whey. Auxiliary raw materials used in the production of the drink are pasteurized milk with 3.2% fat and 3.2% protein; unsweetened UHT milk condensed with 7.5% fat, 6.6% protein and 17.5% skim milk solids; and skimmed milk powder with 0.2% fat,

35% protein and 96% common solids (all from SM Gostyń, Poland).L. acidophilus LA-5 or B. animalis ssp. lactis BB-12 (both Chr. Hansen, Hørsholm, Denmark).

The acid serum was subjected to thermal processing at 72 ° C for 10 minutes and cooled to about 20 ° C. In a preliminary study, we found that thermal treatment allowed the total number of bacteria to be reduced from 7 log to 1 log cfu/ml (data not shown). Next, we mixed the whey with milk, condensed milk or skimmed milk powder. The ratio of whey and milk types is shown in Table 2.

The mixtures were heated to 42 ° C and L. acidophilus LA-5 (drinks La1, La2 and La3) or B. animalis ssp's 0.6 g/l direct boiler package was inoculated with starter culture. Laktis BB-12 (drinks Bb1, Bb2 and Bb3). The mixtures are poured into low-density polyethylene containers (capacity of 50 ml), tightly closed with aluminum foil and for 7.5 hours at 42 ± 1 ° C (L. drinks with acidophilus) or 6.5 hours (B. drinks with animalis ssp) are incubated.lactis) until hard cottage cheese is obtained. Preliminary research results.

Table 2. Composition of probiotic fermented drinks based on acid whey

Drink	Basic ingredients (%; weight / weight)			Skimmed milk powder (g/100 g)	Probiotic culture
	Whey Milk	Whey Milk	Condensed milk		
La1	50	50	0	5	*Lactobacillus acidophilus* LA-5
Bb1	50	50	0	5	*Bifidobacterium animalis* ssp. *Laktis* BB-12
La2	50	25	25	—	*Lactobacillus acidophilus* LA-5
Bb2	50	25	25	—	*Bifidobacteriumanimalis* ssp. *Laktis* BB-12
La3	50	0	50	—	*Lactobacillus acidophilus* LA-5
Bb3	50	0	50	—	*Bifidobacterium animalis* ssp.

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