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# Uses of Whey: A Review

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**ABSTRACT**

*Whey is the liquid remaining after the separation of milk fat and casein from whole milk. Whey is a by-product of dairy industries, particularly the liquid that is formed during the coagulation of milk casein in cheese making or in casein manufactures. Whey produces in large amounts and is discarded in the ecosystem, causing considerable environmental problems. This kind of pollution affects the quality of water, air and soil. Due to its enormous production, it became a very large organic pollutant for environment. There is a need of a process to convert the nutrients in whey such as carbohydrates, proteins, lipid, and minor constituents with high market values into the production of valuable food products. Whey can also be used to obtain valuable chemical compounds that are useful in the fields of health, pharmaceuticals, food, plastics and fuels.*

***Key words:*** *Whey, food, liquid, cheese, products.*

## INTRODUCTION

Whey is a liquid by-product produced during the manufacturing process of cheese. Whey is a yellowish residual liquid remaining after casein is precipitated out from milk using enzymes or acids[1]. There are two different types of whey: sweet whey and acid whey. Sweet whey is a by-product of ripened cheese production (pH 5.8–6.6) whereas acid whey is obtained from cottage cheeses (pH 3.6–5.1)[2]. To make 1 kg of cheese, 9 kg of whey is generated[3]. Because of its low concentration of milk constituents (whey is only 6-7% dry matter), whey has commonly been considered a waste product.

The worldwide production of fluid whey by the cheese and casein industries runs into millions of tons, and yet effective utilization of this material is not well developed. World annual production of whey is estimated to be 115 million tons; approximately 47 % of the produced whey is disposed into the environment[4].

**Need of whey utilisation**

Whey represents an important environmental problem because of the high volumes produced and its high organic matter content[5]. It is uneconomical to transport whey because of its high water content. Drying whey requires a large capital investment, is energy intensive, and is not economically profitable[6&7].If this industrial effluent is discarded in the soil without prior treatment, it can modify the soil's physical and chemical composition, reducing crop yields and the availability of oxygen in water[8,9&10].

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The uncontrolled disposal of the whey not only results in significant environmental and public health problems such as global warming, acidification, oxygen depletion, eutrophication, odor, etc. but should also be regarded as an economical loss. The conversion of these wastes and wastewaters into industrial chemicals will reduce our foreign dependency, lead to important economic and ecological gains, refresh rural economies through new perspectives and investments.

The most successful way to redeem whey solids is considered to be the production of WPC by the application of ultrafiltration (UF) system[11&12]. Ultrafiltration is also being used to effectively recover protein contents of waste before their disposal to outside environment[13]. Microfiltration is also used as a pretreatment, just before the ultrafiltration, to make the waste free from all the suspended or colloidal particles, fat and casein particles, so as to minimize the fouling effect on the ultrafiltration membrane[14].

The aim of this article is to present whey as a valuable, nutritious food for human consumption and describe its use as a raw material for manufacturing a variety of products. Effective and economical methods of utilizing whey are essential to get good returns. In terms of whey utilization there are so many things that can be done instead of treating whey as a waste. Valuable components can now been taken advantaged in very phosphorous ways.

Regulations about the use of whey are based on Codex Alimentarius concerning milk and milk products launched by the World Health Organization Food and Agriculture Organization of the United Nations[15].

Whey represents 85% - 90% of the original milk volume and retains 55% of the nutrients. Milk whey has proteins, lipids, soluble vitamins, minerals and carbohydrates. Of the total whey solids, 75% is lactose. Lactose is one of the most polluting by-products because of its high biochemical oxygen demand (BOD) < 35,000 ppm and its chemical oxygen demand (COD) < 60,000 ppm[16].

**Uses in the foods**

Whey proteins are being considered as versatile constituent of whey due to their excellent nutritional and functional properties[17&18]. Whey proteins are used not only as nutritional supplement but also as functional ingredients in foods[19]. The best physical and functional properties of whey proteins are solubility, viscosity, cohesion and adhesion, emulsifying properties, water sorption and gel-forming properties[20].

These properties may be used in the preparations of certain valuable foods. Caric reported that the incorporation of whey improves the sensory and textural properties of foods[21]. The whey used as a substitute for normal water in food products and it may also improve the nutritional value of the food products. Whey proteins are widely used during the production of salad dressings, soups and sauces, mayonnaise, meat, yoghurts and ice cream preparations[22,23,24&25].

Whey protein isolates contain protein concentrations of 90% or higher. During the processing of whey protein isolate there is a significant removal of fat and lactose. As a result, individuals who are lactoseintolerant can often safely take these products[26]. Wan[27] reported that the compounds from hydrolyzed whey contains great economic importance, as its proteins are using as a supplement in animal feed and exploited for their functional and nutritional properties in the food industry[27].

Furthermore, whey can be fermented by small cheese plants for wine production, since no elaborate or expensive equipment is required. Utilization of whey for wine production requires few of any energy resources. The entire whey is utilized; no removal of water is necessary. Wine production capital outlay is low because no elaborate or expensive equipment is required.

Whey can be used as starter cultures (baker's yeast or probiotic starter cultures for fermented milk products and for cheese ripening)[28]. A yeast strain, named as *Kluyveromyces marxianus*, was used for the production of ethanol from whey protein at a

temperature above 40°C[29]. Whey can be used as substrate for fermentation by yeast like *Kluyveromyces fragilis*. These types of yeast are commonly used to hydrolyze lactose present in milk whey. The acquired ethanol from the hydrolyzation could be used to produce alcoholic beverages or for other industrial applications[30].

The lactose of whey is converted to other compounds such as organic acids (acetic acid, propionic, lactic and succinic) or biofuel (bioethanol) obtained by microbial fermentation[31,5&32]. The biological conversion of lactose content into lactic acid using appropriate species of *Lactobacillus* has the double advantage of alleviating a pollution problem and at the same time, producing a marketable product[33].

## OTHER USES OF WHEY

Beyond nutrition and food, whey proteins are used as surfactants in different cosmetic applications[34] and also as plastic films for coatings foods, drugs and special papers[35 & 36]. It is very biodegradable substrate (~99%) with very high organic content (~ 70 g COD/l) and low alkalinity content[37]. Whey proteins are also used in paper coating to provide good appearance, printability and low water vapour permeability[36].

Zall[38] described the possible waste minimisation routes of whey[38]. They are application of techniques minimising whey production during cheese making, usage of whey as a valuable by-product in the food industry, production of petrochemicals such as methane and methanol, production of lactic acid and its derivatives (potentially as green solvents), production of biodegradable plastics and polymers, treatment of whey like a sewage.

Taking all these advantages and facts into consideration, production of whey based products will lead to important economic gains.

## CONCLUSION

Whey is the watery and thin liquid, which is received during cheese making by coagulating and separating casein proteins from milk. Whey is produced in large quantities and usually disposed off causing major environmental pollution, due to its high organic load. Whey proteins possess many beneficial properties as well. Whey is rich in nutrition. Whey products are also evident in baked goods, salad dressings, emulsifiers, infant formulas, and medical nutritional formulas. It can be conclude that this approach considers wastes not only in terms of their treatment/disposal, but also as a valuable resource for product formation, economical gains through new perspectives and create new employment opportunities.

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