

# Biological Synergism in Whey Protein Concentrate Formulations Sweetened with Steviol Glycosides

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## ABSTRACT

**Background and Objective:** Innovative nutraceutical formulations of whey protein concentrate sweetened with steviol glycosides recently appeared with marketing for improving quality of life (QoL) in patients with non-communicable diseases (NCDs) and people with special food needs. Synergism between whey protein and stevia leaf extract evaluated in well-structured review was highlighted here to endorse the application of this combination in nutraceutical formulations. **Materials and Methods:** Well-structured publications with complete methodologies were studied thoroughly to extract the valuable updated data to be presented in an informative and concise way. **Results:** After the examination of the methodology and results of the well-structured publications concerned with the effect of mixing whey protein (concentrate or isolate) and steviol glycosides, it is noteworthy to mention and highlight the biological synergism noticed *in vivo* upon consumption of regular diets of formulations of whey protein concentrate with steviol glycosides sweetener. **Conclusion:** The current paper presents evidence-based facts about the biological synergism between whey protein and stevia leaf extract when mixed together in formulations for improving quality of life (QoL) in patients with non-communicable diseases (NCDs).

## KEYWORDS

Whey protein concentrate, *Stevia rebaudiana* Bertoni, steviol glycosides, malnutrition, non-communicable diseases

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## INTRODUCTION

The desire for a healthy lifestyle has recently become a long-lasting trend, which has sparked the growth of a new sector of the food market incorporating functional foods. Foods that are functional have positive effects on one or more bodily functions in addition to meeting basic nutritional requirements, which is good for human health. Functional foods contain one or more ingredients that have been altered, added, or deleted in order to improve a specific physiological process or lessen negative health impacts<sup>1</sup>.

The popularity of protein drinks has grown recently. A parallel rise in interest in natural sweeteners coincides with this rise in consumption. Natural noncaloric sweeteners, like stevia, were used in the



formulation of naturally sweetened ready-to-mix (RTM) whey protein drinks to add sweetness. The most popular label claim among consumers was "all natural"<sup>2</sup>.

Whey protein concentrate (WPC) is a vital food ingredient with many functional properties and high nutritional value. The interaction between proteins and polyphenols can effectively improve protein utilization. The interaction of milk proteins with polyphenols decreases the allergenicity of whey proteins in vitro and improves their emulsifying and antioxidant characteristics. In addition, polyphenols are also involved in the taste and color of foods, so interactions between proteins and polyphenols can also improve the sensory attributes of foods<sup>3</sup>.

Stevia leaves contain a variety of phenols and polyphenols as non-enzymatic antioxidants mainly composed of chlorogenic acids and flavonol triglycosides, flavonoid mono and diglycosides and their hydroxycinnamoyl derivatives. Increased consumption of polyphenols, especially flavonoids, has been linked to a lower risk of neurodegenerative disorders, cancer and cardiovascular disease, according to several epidemiological studies<sup>4</sup>.

Novel nutraceutical formulations including whey protein concentrate, steviol glycosides, natural flavors fortified with vitamins and minerals have been structured recently on a scientific basis and subjected to complete physicochemical, microbiological and sensory evaluation analysis<sup>5</sup>.

The aim of the current paper was to highlight some of the important facts in the industrial structure of formulations containing whey protein concentrate and steviol glycosides in a biological synergism where scientific papers mentioned the efficacy and synergism of combining whey protein with steviol glycosides.

## **MATERIALS AND METHODS**

Well-structured publications were studied thoroughly to extract the valuable updated data to be presented in an informative and concise way.

To prove the potency of this biological synergism between whey protein and stevia leaves extract sweeteners, a trial with four groups of rats with different physical activity (sedentary, trained, trained receiving whey protein and trained rats receiving whey protein with stevia leaves extracts) were subjected to the physical performance test of resistance training by climbing a ladder 5 days/week, for a test period of 8-weeks. The training program involved 4 climbs along with carrying a load of 50, 75, 90 and 100% of maximum load-carrying capacity. By the end of test period, plasma and tissues samples were collected from the 4 participating groups to assess the biochemical, histological and molecular parameters in the working rats<sup>6</sup>.

The effect of whey protein supplemented with *S. rebaudiana* Bertoni was studied in three groups of diabetic rats: A group eating whey protein only, a group eating *S. rebaudiana* Bertoni only, a group eating the mixed diet (whey protein and *S. rebaudiana* Bertoni), with monitoring insulin secretion and its role in mitigating streptozotocin-induced hyperglycemia. Insulin levels were measured in plasma using the radioimmunoassay (RIA) with the viability of the  $\beta$  cells detected by immunohistochemistry (IHC)<sup>7</sup>.

## **RESULTS AND DISCUSSION**

Whey protein supplements may be packaged as unsweetened products and the consumers add their favorable sweeteners as they want, or they may be naturally sweetened with sucrose which has much calories and may not be suitable for diabetic patients, or may be artificially sweetened with acesulfame potassium or sucralose. Artificial sweeteners were found to induce glucose intolerance, showing harmful

consequences on glucose homeostasis. Thereby, natural sweeteners developed in food industries to replace artificial ones. *Stevia rebaudiana* Bertoni earns increasing attention with the sweet taste of steviol glycosides. Many bioactive compounds are moreover found in the leaves of *S. rebaudiana* Bertoni which may be accountable for its recognized functions, as antioxidant and antimicrobial activities with numerous health-promoting properties as anticarcinogenic, antidiabetic, antihypertensive and anti-inflammatory. Consequently, steviol glycosides may be a potent alternative to artificial sweeteners to boost the functional properties of formulations of whey protein, improving their effects on physical performance, nutritional status and health. Results revealed that the rats receiving whey protein with stevia leaf extract showed higher values of the maximum load-carrying capacity with growth in the gastrocnemius and soleus muscle pads with PGC-1 expression is upregulated, followed by a very similar pattern in the expression of the TFAM protein, two key indicators of mitochondrial biogenesis, together with elevated AMPK phosphorylation. Also, the whey protein sweetened with stevia leaf extract encouraged the substantial decrease in retroperitoneal adipocyte diameter with increasing the weight of brown adipose tissue pads in resistance-trained rats which is considered a prospective approach to be applied in routine diets formulations including whey protein and stevia for athletic and patient people suffering from metabolic disorders, obesity and diabetes in order to increase muscular mass and strength with enhanced mitochondrial functions<sup>6</sup>.

In the second study, results revealed that diabetic rats treated with the experimental diet of whey protein supplemented with *S. rebaudiana* had a better recovery from insulinemia, with insulin levels ( $\sim 0.13 \text{ ng mL}^{-1}$ ) like non-diabetic rats and exhibited a higher number of ( $\sim 66\%$ ) in immunohistochemistry (IHC) analysis of insulin-positive pancreatic B cells, while the other two diabetic rats groups eaten only the separate portions of *S. rebaudiana* Bertoni or whey protein exhibited 38 and 59% of positive cells, respectively.

The aforementioned findings confirm the potency of whey protein supplemented with stevia leaf extract restored the survival of streptozotocin-damaged pancreatic B cells, leading to a rise in insulin release, indicating that this diet can be utilized as an addition to or supplement to diabetes treatment regimens. *S. rebaudiana* Bertoni helped to regenerate the viability of streptozotocin-injured pancreatic B cells and accordingly increased insulin secretion, signifying that this diet can be used as an adjunct or supplement in diabetic treatment protocols<sup>7</sup>.

## CONCLUSION

The current paper successfully presented evidence-based facts about the biological synergism effect between whey protein and stevia leaf extract when mixed together in formulations for improving quality of life (QoL) in patients with non-communicable diseases (NCDs) in an informative and concise approach to highlight this important finding with further exploration of synergistic effects of whey protein and steviol glycosides could contribute valuable insights to the scientific community and healthcare industry.

## SIGNIFICANCE STATEMENT

The research addresses an important topic in the context of nutraceuticals, which play a crucial role in enhancing the Quality of Life (QoL) for various groups of people, including those with noncommunicable diseases, malnutrition and specific nutritional needs. The concept of a biological synergism between whey protein and steviol glycosides is intriguing. It suggests that combining these two components may have a greater impact than using them separately, which could be of interest to researchers and manufacturers of dietary products. Overall, the article addresses a potentially impactful topic in the field of nutraceuticals. Further exploration of synergistic effects of whey protein and steviol glycosides could contribute valuable insights to the scientific community and healthcare industry.

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