

A Review on Whey Protein: Benefits, Myths and Facts

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Abstract:- The popularity of whey protein among athletes and the bodybuilding community has grown significantly. Whey is a by-product of the dairy industry's process for manufacturing cheese. It constitutes only 20% of milk. It contains minerals, water, lactose, protein, and fat. Whey protein is a potent source of many benefits. Its antibacterial, antitoxin, and immunomodulating properties aid in the treatment of many ailments. It also plays an important role in the healing of burns and wounds. It has antioxidant qualities that aid in the battle against HIV. Whey protein promotes muscle growth and strong bones, in addition to improved athletic performance in athletes and bodybuilders. It aids in preventing cancer, cardiovascular diseases, obesity, and type 2 diabetes. Whey protein is a necessary supplement for those who engage in physical activity, like sports and exercise. It also benefits sedentary adults, newborns, expectant moms, and elderly people. However, in spite of its numerous benefits, there are many myths that surround whey proteins and therefore, are considered only for athletes and gym-goers. The present review attempts to cover an overview of whey protein, its components, types, and benefits. It also aims to dispel different fallacies about whey protein by presenting evidence from scientific studies.

Keywords:- Whey, protein, athletes, muscle, weight.

I. INTRODUCTION

In the everyday lives of the average person, drinking milk has been a routine practice. It has been passed down the generations with the belief that milk is a crucial food for the body since it strengthens the body, particularly the bones and teeth. But for a very long time, whey—a significant component of milk—has received little attention. Whey is a by-product of the cheese or paneer manufacturing industry and includes whey protein among its protein constituents. Whey contains significant amounts of top-notch protein. Whey has been used as part of folk medicine for disease prevention and treatment by many cultures and communities for hundreds or even thousands of years. Whey was frequently prescribed for treating many illnesses during this time, including acute septic diseases and gastrointestinal infections. According to history, whey was extremely therapeutic in Ancient Greece and the Middle Ages and was used as a skin balm, an aphrodisiac, to treat burns, and to treat a variety of ailments [1]. Whey is used as a marinade or preservative for meat and other foods, and Syra, the most popular beverage in Iceland, is named after it [2]. According to Italian literature, the early 17th century has references to a variety of whey's health benefits [3]. The need for whey

protein has only recently increased, despite the fact that its nutritional value has been known for decades. Whey proteins demonstrate a higher nutritional value when compared to plant proteins, and they are regarded as one of the highest quality proteins in the food and nutrition sector [4]. Covering literature of around 30 years, this review will focus on the components and benefits of whey protein.

II. COMPONENTS OF WHEY PROTEIN

Whey proteins consist of protein, lactose, water, minerals (calcium, magnesium, phosphorus), and fat [2]. The two primary types of protein in milk are casein (80%) and whey protein (20%). While casein is what causes curd to form, whey proteins are a group of milk proteins that are present in the milk's aqueous solution [5]. Caseins, which are phosphoproteins, are formed from the precipitate of raw milk by acidification. The phosphoproteins are disseminated in milk as micelles, which are held together by κ -caseins. In milk, a colloidal suspension of the casein micelle granules is kept. On the contrary, after casein precipitation, whey proteins are the proteins that are still soluble and consist of nearly 50% β -lactoglobulin, 20% α -lactalbumin (α lac), 10% albumin, and remaining contains lactoferrin with lactoperoxidase [6]. These globular proteins are susceptible to heat denaturation and are more water soluble than caseins [7]. Casein is referred to as a "slow" protein and whey protein as a "fast" protein because casein is digested in the stomach more gradually than whey proteins. The idea behind whey protein, which is referred to as a "fast blend," is that when consumed, it will cause an immediate rise in blood levels of amino acids. Casein protein, on the other hand, is referred to as a "slow mix" and will cause a gradual, persistent rise in blood amino acids over the course of several hours. The combination of whey and casein protein may therefore be advantageous in promoting muscle protein synthesis and boosting muscle mass over a rigorous resistance-training program [8, 9]. Following resistance training, consuming casein or whey protein led to positive amino acid balance, a sign of net muscle protein synthesis. Casein is transformed into a solid clot and is emptied from the stomach more slowly than whey proteins because they remain soluble in the stomach [10]. A healthy metabolism depends on whey proteins, which are divided into major and minor protein fractions with varying molecular weights. Major whey proteins include β -lactoglobulin, α -lactalbumin, serum albumin, immunoglobulins, and glycomacropeptide, while minor proteins include lactoperoxidase, lactoferrin, β -microglobulin, lysozyme, insulin-like growth factor (IGF), γ -globulins and a number of other tiny proteins [7]. There are various components of whey protein which include, β -Lactoglobulin, α -Lactalbumin, Bovine serum albumin,

Immunoglobulins (A, M, and C), Lactoferrin, Lactoperoxidase, Glycomacropetide. Table I illustrates the whey protein profile along with its chemical properties [5].

Protein	Concentration (g/l)	Molecular weight (kDa)	Number of amino acids residues
β -Lactoglobulin	1.3	18277	162
α -Lactoalbumin	1.2	14175	123
Bovine serum albumin	0.4	66267	582
Immunoglobulins (A, M and C)	0.7	25000 (light chain) 50000-70000 (heavy chain)	-
Lactoferrin	0.1	80000	700
Lactoperoxidase	0.03	70000	612
Glycomacropetide	1.2	6700	64

Table 1: Whey Protein Profile and Their Chemical Properties [5]

The functional properties of the proteins in whey are shown in Table II.

Protein	Functional properties
β -Lactoglobulin	Good foaming, emulsifying, and gelatin properties. Good solubility, aroma binding ability
α -Lactoalbumin	Good foaming and emulsifying properties. Good solubility
Immunoglobulins	Good gelation properties and solubility
Serum albumin	Good gelation properties and solubility
κ -Caseinmacropeptide	Good emulsifying properties
Protease peptones	Good emulsifying and foaming properties
Lactoferrin	Good solubility, iron-binding ability
β -Lactoglobulin	Good foaming, emulsifying, and gelatin properties. Good solubility, aroma binding ability

Table 2: Functional Properties of Proteins in Whey [11]

Branch-chain amino acids (BCAAs) and essential amino acids (EAAs), which are necessary for the growth and repair of human tissues, are present in whey protein, a high-quality protein [12]. A high-quality source of amino acids, antimicrobial activity, growth promotion of beneficial gut flora, immune-boosting qualities, toxin-fighting capacity, and prevention of some diseases, such as cancer, are just a few of whey protein's nutritional benefits [2].

III. TYPES OF WHEY PROTEIN

Mignone et al. (2015) and Shankar and Bansal (2013) in their review works, illustrated the various types of whey protein, namely, whey protein concentrate (WPC), whey protein hydrolysate (WPH), and whey protein isolate (WPI).

Whey protein concentrate contains 35-80% of protein and some amount of minerals, lactose, and fat. It has the best flavor among the three types of whey protein [13]. Whey protein concentrate, which has a high concentration of amino acids and promotes muscle building, is very advantageous for bodybuilders [14].

Whey protein isolate is a further processed protein that is produced after all the fat and lactose are removed and has 85-90% protein content [13]. It is effective for both muscle growth and fat loss because of its excellent amino acid profile [14]. Many beneficial nutrients that are found in WPC are lacking in it [13].

Whey protein hydrolysate, also known as hydrolyzed whey, is the 'predigested' form of whey protein. This type of whey protein is easily absorbed in the body and doesn't require much digestion, since it has undergone partial hydrolysis [13].

Among the three types of whey protein, Whey protein concentrate is the most widely used protein powder because of its taste and the beneficial nutrients found in it. WPC is also the low-cost protein powder among the three types [13].

IV. HEALTH BENEFITS OF WHEY PROTEIN

Supplementation of whey protein has proven to be highly beneficial [1]. Whey contains biologically active molecules capable of enhancing intestinal health [7]. The best-known benefits of whey protein include its capacity to aid in weight loss, raise lean muscle mass, and improve immunity [2, 15]. It has a large and evenly distributed supply of amino acids, which have a significant antioxidant effect. Additionally, it stimulates the immune system, has anticancer properties, boosts the body's protein metabolism, and changes the composition of the body [1, 3]. Whey proteins give antibacterial and immune-associated protection to the neonate against illness. In the fight against depression and stress, whey proteins may also be used as a safe and effective supplement [7]. Whey proteins operate as anti-cariogenic agents and have a preventive impact against dental enamel demineralization [7]. Whey protein helps to increase serotonin activity and helps to promote restful sleep [14].

A. Whey Protein as a Fighter Against Illnesses

Whey protein contains antiviral and antibacterial effects. Whey contains a number of substances that can protect the body against various bacteria, viruses, and toxins. Whey protein boosts immunity and protects against disease. Whey protein is said to be effective in treating rotaviral diarrhoea, a common infection in children and newborns. Whey protein increases glutathione production in HIV-positive youngsters, which helps lower infection. Additionally, doctors will prescribe it following surgery or burn therapy.

Whey can operate as an antioxidant, hypolipidemic, antiviral, anticancer, antibacterial, antihypertensive, and chelating agent [1,12]. Protein deficiency prolongs the healing process after surgery, and adequate protein intake is necessary [16]. Whey protein has been shown to increase cognitive function and coping in those who are under a lot of stress in human studies [16]. Lactoferrin, a protein found in whey, has antitoxin, antimicrobial, and immunomodulating effects. Additionally, it can shield the body from numerous illnesses like hepatitis, influenza, and cytomegalovirus [12]. Whey protein helps the body heal damaged tissues and can prevent psoriasis and ulcers [4]. Research suggests that whey protein may help reduce bacterial respiratory infections and allergies. Additionally, it protects against DNA deterioration, fights colitis, and treats fatty liver [17]. By boosting the antioxidant glutathione's activity, whey protein can lessen the negative effects of oxygen radicals and lipid peroxidation while also promoting the growth of fibroblasts and the release of both pro- and post-inflammatory cytokines [18]. Whey protein is a good source of glutamine and the branched-chain amino acids required for cell growth, as well as both essential and non-essential amino acids [19]. Leucine, isoleucine, and valine are branch-chained amino acids that aid in bone, skin, and muscle tissue healing. The amino acid proline helps to make collagen, which repairs cartilage and fortifies tendons, joints, and heart muscle [20]. In the antioxidant system, whey protein modulates the immune system. Supplementing with whey protein concentrate may increase glutathione production and reduce the likelihood of related co-infections in HIV patients [21]. In individuals with advanced HIV infection, whey protein supplementation steadily raised plasma glutathione levels [22, 23].

Whey protein as a nitrogen source may decrease inflammation and increase antioxidant defenses in elderly patients admitted to ICU due to acute ischemic stroke [24]. Supplementing with whey may improve human health by lowering levels of circulating C-reactive protein (CRP), a sensitive indicator of inflammation. According to a meta-regression analysis, the initial CRP level may have influenced how well whey supplementation reduced CRP [25]. The body's immune system is regulated and antibacterial activity is provided by whey protein [2, 15]. Patients with hepatitis B show healing effects from whey protein intake [16].

B. Whey Protein Against Cancer

Whey protein has anticarcinogenic properties [26]. Cancer patients receiving chemotherapy or radiation treatment, experience various side effects, including nausea and loss of appetite. As a result, they find it difficult to consume enough food to meet up their daily nutritional needs. Whey protein, being easily digestible and very gentle to the body, comes as a saviour in such cases [1, 2]. According to research, whey protein guards against the growth of colon, breast, and intestinal malignancies [1]. Whey protein stimulates immunity via the GSH pathway, which has an anti-tumour effect on modest volumes of the tumour. By raising GSH levels, which may help detoxify possible carcinogens, it may also have an anti-carcinogenic impact [27]. The prostate tissue in humans is especially

vulnerable to oxidative stress. GSH and GSH-dependent enzymes shield the prostate from oxidative stress, which may be crucial in halting the growth of prostate cancer. The cystine required to boost GSH synthesis and defend against oxidant-induced cell death in the human prostate can be found in whey proteins [28]. Cancer prevention has a lot of potential when calcium-rich foods and whey protein are consumed as high-quality protein sources [29]. Case studies are given that strongly imply a whey protein dietary supplement has an anti-tumour impact in several urogenital malignancies [30].

C. Whey Protein for Cardiovascular Health

Whey protein has the potential to improve cardiovascular health. It reduces the triglyceride levels in the blood. Additionally, it keeps blood pressure levels at a healthy level in overweight or obese people [1, 2, 31]. Whey protein lengthens the lifespan in older people by increasing the content of glutathione in their hearts and livers [32]. Whey protein has the ability to reduce osteoporosis as well as cardiovascular disease [2, 15]. In people with hypertension, whey protein can lower blood pressure [2]. Whey protein aids in the battle against hypertension [14]. It also has the responsibility of lowering a person's bodily cholesterol levels, which improves cardiovascular health [2]. The risk of cardiovascular disease can be decreased by taking whey protein supplements, which have been found to lower systolic blood pressure, lower triglycerides, and increase HDL levels [16].

D. Whey Protein for Muscle Growth

A good source of amino acids is whey protein. The ability of the body to reassemble and repair muscle tissue is controlled by these amino acids. Additionally, they support the growth of muscles and the production of muscular protein. Muscle strength and body composition are enhanced by whey protein [2, 15]. Whey protein assists in nourishing muscles and promoting the growth of larger, stronger muscles as a result [1]. Proteins promote the accumulation of muscle proteins by providing the essential amino acids required for muscle anabolism during exercise [10]. Lean muscle mass can be maintained while lowering body fat thanks to whey protein [33].

According to Lands, Grey and Smountas(1999), supplementing one's diet with whey protein, which is high in the oxidized form of cysteine, can increase GSH levels and enhance muscular performance [34, 35]. To increase muscle strength and mass, body composition, and systemic and local indicators suggestive of skeletal muscle anabolism and hypertrophy, heavy resistance training combined with the timed intake of a supplement containing whey, casein, and free amino acids is more effective than a carbohydrate placebo [8]. Whey proteins have a high protein quality rating and a comparatively high amount of branched-chain amino acids. In this context, the high levels of leucine in whey are particularly intriguing. Leucine has been recognized as a crucial signal in the translation start pathway of muscle protein synthesis and has a specific role in protein metabolism [36].

E. *Whey Protein for Weight Loss*

Whey protein is the best protein for weight management and fat loss when paired with a balanced diet and exercise. It also reduces waist size and enhances body composition. Being highly satiating in nature, it reduces appetite and regulates the hormones which control hunger in a body. Whey protein may also aid in reducing inflammation in the body [1]. In comparison to casein, whey protein has been reported to reduce fat mass and increase lean body mass to a greater level [6]. It has also been discovered to cause a reduction in body fat mass compared to carbs [6].

In comparison to casein and carbohydrate supplementation, whey protein supplementation seems to have a beneficial and acute postprandial effect on satiety and fullness in overweight and obese people [37]. Whey protein has a higher capacity to support changes in body composition brought on by exercise [38]. Whey protein promotes satiety in comparison to other dietary proteins, which reduces a person's food consumption [39]. The use of whey protein in the management of Type 2 diabetes and obesity is supported by its induction of satiety, enhanced thermogenesis, and comparable magnitude of blood glucose decrease to pharmaceutical treatment [40]. Leucine is one of the specific whey protein components being researched for its potential to increase satiety, affect glucose homeostasis, retain lean body mass, and stimulate fat loss. Whey is efficient at boosting satiety and controlling calorie intake, which may lead to a reduction in body fat and weight [41].

F. *Whey Protein for Bone Development*

Whey protein plays a key role in bone formation and also decreases bone breakdown. It has the potential to heal bone disorders and physiologically regulates bone growth [1]. In healthy adult men, whey protein encourages bone formation, inhibits bone resorption, and affects bone metabolism while maintaining a healthy level of bone remodeling [42].

G. *Whey Protein for Expecting Mothers and Infants*

Infants and expectant mothers can benefit greatly from whey protein. It is a crucial component in a range of infant formula milk powders since it contains a number of components that are also found in breast milk. Whey protein is a top-notch source of protein and is a great supplement for expecting mothers. Additionally, tears and irritability in babies with colic have been shown to decrease when whey protein is included in newborn formulas [1, 12]. In infant formula with reduced allergenic characteristics, whey protein hydrolysates have been employed as the main nitrogen source [15].

H. *Whey Protein Against Diabetes*

Whey protein is a fantastic dietary supplement for diabetics who must watch their food intake. Whey protein offers diabetics more protein and other nutrients than other low-quality proteins, which can contain high levels of fat and cholesterol. Additionally, it aids in maintaining healthy body weight and blood glucose levels [12, 2]. Whey protein also helps to lower blood pressure as well as stress and depressive symptoms [12]. Whey has insulinotropic effects in diabetics who are on a diet as well [43, 44]. Essential

amino acids and BCAAs, which are known to have insulinotropic characteristics, are abundant in whey protein [13]. The glycemic index of a diet is lowered by including proteins. Low glycemic index diets might protect against Type 2 diabetes. When compared to caseins or other animal and plant proteins, whey proteins are found to be more insulinotropic [40].

In addition to healthy individuals, Type 2 diabetic patients also experience a reduction in blood glucose levels and an insulinotropic effect from whey protein [40]. Whey protein increases the release of insulin through bioactive peptides and amino acids produced during gastrointestinal digestion, which results in decreased food intake and enhanced satiety. The glucose-lowering impact and the regulation of food intake are linked to insulin secretion. Potentially, the postprandial blood could be reduced by the insulinotropic impact of whey proteins. Excursions of glucose throughout the day may help Type 2 diabetes patients maintain glucose homeostasis and delay the start of medicinal treatment. Whey protein may be a safer alternative to frequently used medicinal drugs in its capacity to increase insulin secretion [40]. Whey protein aids in blood glucose regulation and offers extra advantages for weight management, a problem for type-2 diabetes [14].

I. *Whey Protein in Athletic Performance*

A good sportsperson or an athlete possesses the qualities of outperforming in competition and performing up to the maximum potential. This drive to succeed has raised the demand for high nutritional supplements among athletes to enhance their athletic performance [45]. Whey protein raises the body's glutathione levels, which promotes immunity in athletes and other sportspeople. The antioxidant glutathione is a crucial component of a strong immune system. Exercise and physical training may cause a person's glutathione levels to drop. Whey protein controls glutathione levels, assisting athletes in maintaining a fit and powerful body [12].

For athletes, whey protein is recognized as the "gold standard" of proteins. It has the perfect ratio of amino acids, which helps to enhance body composition and increase athletic performance. Muscle tissue is metabolized, repaired, and rebuilt with its assistance [2]. Leucine, an amino acid that encourages muscle protein synthesis and muscle growth, is a key component of whey protein and is a great source of it. It keeps athletes in top physical condition so they can compete at their peak [2]. Burke, Chilibeck and Davidson (2001) showed that males utilizing whey protein concentrate as a supplement while participating in weight training programs improved their strength more than those using resistance training alone [46]. Whey is the best protein source for body composition, supporting protein synthesis and muscle building thanks to its amino acid profile. Other bioactive substances in whey may enhance immunological function, promote gastrointestinal health, and have anti-inflammatory effects, which may help further aspects of health in physically active persons and trained athletes. Common concerns among athletes, such as recurrent infections and gastrointestinal disorders, can be positively

impacted by whey components such as, glutamine and lactoferrin [16].

J. *Whey Protein in Asthma*

Whey protein also plays an important role in curing asthmatic troubles. It helps to treat asthmatic patients by boosting the immunological system of the body [47]. In a study by Lothian, Grey and Lands (2006), it was demonstrated that, prolonged supplementation of whey protein has the potential to improve the immune system in patients suffering from atopic asthma, without showing any kind of adverse effects. It is also suggested that antioxidant supplementation also plays an important role in treating asthma [48].

K. *Whey Protein in Gut Health*

A review by Sangwan and Seth (2021) gave an insight into the gut and prebiotic action of whey protein along with its other benefits. Patients who are critically unwell have improper gut functioning and can no longer absorb nutrients from even bland food due to which their health starts getting affected. Due to the high cost, parenteral feeding cannot be provided to all of these patients.

Whey protein protection may increase inflammation and improve enteral nutrition in these patients. Lactic acid bacteria and yeast must be viable in order to function as medicinal agents. Due to the unfavorable gastrointestinal environment and whey storage, the prebiotic action of whey on the stomach may not be as effective as it may be. Whey protein gels can preserve bacteria by encapsulating them, and they are more effective against harmful circumstances. Low pH is preferable for the *Lactobacillus rhamnosus* CRL 1505 that is encapsulated in whey protein and pectin. Similar to this, microbial carriers in acidic functional foods could be made of pectin beads with a whey protein coating. Whey protein concentrate and high-methoxyl pectin are used to stabilise *Lactobacillus acidophilus* and *Bifidobacterium* in yoghurt beverages. This demonstrates whey's function as a probiotic and prebiotic stabiliser. Alginate microparticles and whey protein isolate have demonstrated efficacy as oral delivery methods for probiotic yeast *Saccharomyces boulardii* [49].

V. SIDE EFFECTS OF WHEY PROTEIN

There is no other natural protein that compares to whey protein in terms of health benefits. However, because whey is a dense protein, there can be dangers associated with eating meals that have been nutritionally refined. If whey protein is consumed for a prolonged period, acne may occur. Bloating, gas, cramps in the stomach, and diarrhoea are some of the most common side effects of whey protein. But lactose intolerance is to blame for the majority of these negative effects. It is brought on by a lack of the lactase enzyme, which is essential for the breakdown of lactose. Furthermore, nearly 75% of people globally suffer from lactose intolerance. Whey protein isolate powder can be utilised in these situations because it is a more refined form of the protein. Compared to whey protein concentrate, it holds less lactose and fat.

Whey protein may cause an allergic reaction in those who have a cow's milk allergy. The symptoms of this type of allergy includes hives, swelling in face and/or tongue and/or throat, rashes, runny or stuffy nose, and a rare, severe, life-threatening allergic reaction, anaphylaxis. Up until the age of three, cow milk allergies can occur, but after that, 90% of people outgrow them [49].

VI. MYTHS AND FACTS AROUND WHEY PROTEIN

Whey protein enjoys wide popularity as a nutritional supplement, particularly among fitness enthusiasts. However, with great popularity, comes bigger notions about protein supplement, both in consumer and industry circles [50]. Therefore, a proper understanding of the protein supplement is essential.

- High-protein diets have raised questions about their potential effects on bone density. However, neither a one-year weight loss trial in individuals with type 2 diabetes nor a two-year weight loss research in postmenopausal women identified any clinically meaningful effects of a high protein diet on bone density [13, 50].
- One of the widely popular myths is that a high-protein diet increases the risk of kidney failure. However, literature reviews in 2005 and 2015 have found no connection between protein and kidney-related diseases. In fact, it was found that the changes caused by protein in the renal system of the body is a normal adaptive process and are well within the functional limits of a healthy kidney [50].
- Another myth surrounding whey protein, which has originated in online fitness forums is that in one meal, the body cannot absorb more than 30 g of protein. However, research proves that in every meal, high-quality protein of 25-35 g is sufficient enough to induce protein synthesis in the body and that any protein intake higher than this limit is never wasted. However, there is a particular recommended daily allowance limit of protein intake of an individual based on their physical activity, and any protein taken more than this limit does not bring any change in the functioning of the body [50].
- High protein intake also raises the question that it may aid in gaining fat. Studies prove that taking high protein in the diet does not cause fat gain but helps in burning fat [50].
- It is a common misconception among many people that protein supplements are just a placebo. This myth is busted by several studies and clinical investigations where it is observed that higher protein intake increases performance in exercises, peak power, and work capacity and promotes muscle thickening in physically active adults [50].

VII. CONCLUSION

The wide-ranging health advantages of whey protein have drawn numerous health supplement businesses to offer nutritional products based on scientific data to wellness and medical consumer sectors. The nine necessary amino acids and branched amino acids included in whey protein make it a valuable and affordable protein source.

Whey protein has potential as enticing, cost-efficient bioceuticals [2]. Whey and its constituents play a number of biological roles, such as antioxidant activity, anticarcinogenic effects, immunomodulation, passive immunity, disease prevention, anti-bacterial, anti-microbial, and anti-viral effects, binding of toxins, promoting cell growth, binding of platelets, anti-inflammatory, and anti-hypertensive actions [7].

Whey protein benefits the pharmaceutical business in a number of ways, including in the treatment of cancer, HIV, cardiovascular disease, osteoporosis, wound healing, and stress adaptation. One of the best sources of protein is thought to be whey protein [14]. The growing need for a cheap supply of protein for people in underdeveloped countries can only be met by whey protein. Excess of everything is bad, and whey protein is no different. Whey protein is still an underutilized supplement and thus, new plans for enhancing its value for human welfare should be made [49].

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