

# Difference Between Protein A and Protein G

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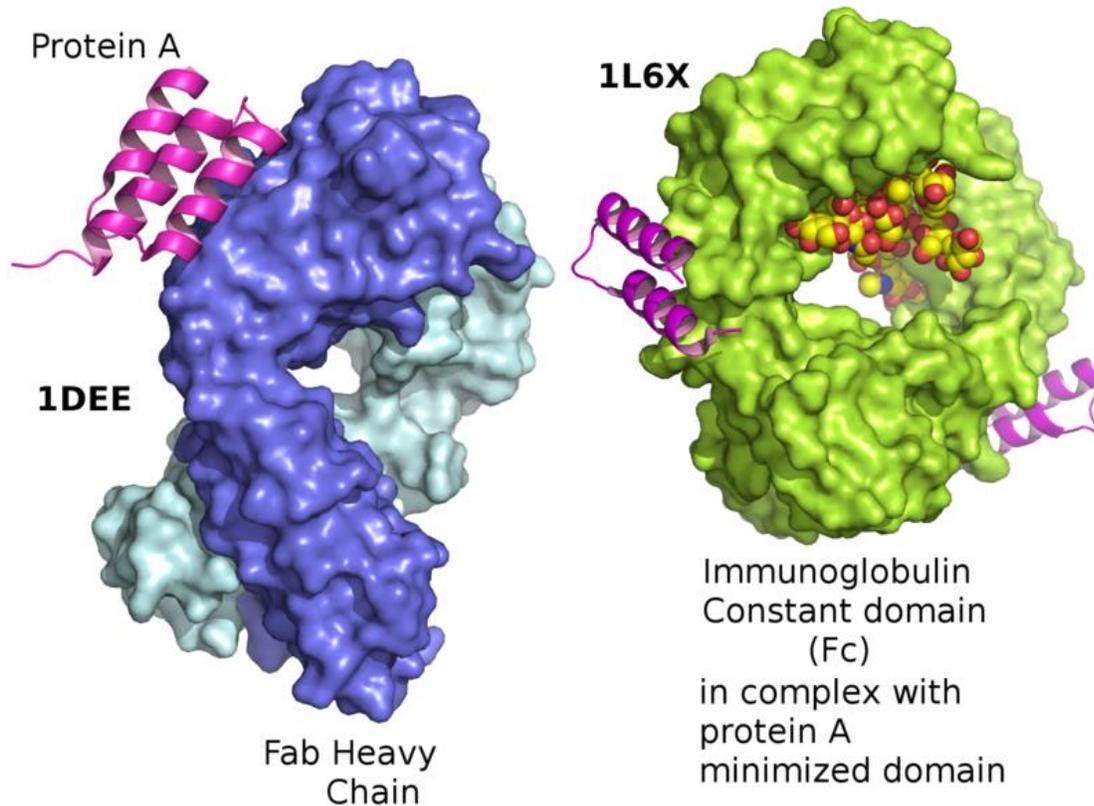
## Key Difference - Protein A vs Protein G

The purification of [IgG antibodies](#), their subclasses and other types of [immunoglobulins](#) ([IgA](#), IgE, IgD and [IgM](#)) have been performed commonly by using bacterial [proteins](#) that have high affinity towards the Fc region of these antibodies. Protein A and Protein G are bacterial recombinant proteins which are highly recommended for the purpose of purification of human and other animals' IgG immunoglobulins. And also protein A, protein G, protein A/G and protein L are native microbial recombinant proteins that have specific binding sites for the Fc region of mammalian IgG antibodies. Other than that, these microbial proteins also can be used to purify other immunoglobulin types such as IgA, IgE, IgD, and IgM in mammals and other animals such as rabbit, mouse, sheep, cow etc. Protein A binds to human antibodies other than IgG antibody. But it is weakly binding with human IgG<sub>3</sub> subclass and it is not binding with human antibody IgD. Protein G binds with all subtypes of human IgG antibodies and it is more versatile when binding to IgG antibodies of other species. However, protein G does not bind to other types of human antibodies other than IgG. **Protein G has a higher affinity towards IgG than protein A.** This is the **key difference** between protein A and protein G.

## What is Protein A?

Protein A is defined as a surface protein that is in the size of 42 kDa. Protein A is originally found in the [cell wall](#) of *Staphylococcus aureus*. It is encoded by the “spa” gene. Protein A is regulated by [DNA](#) topology, cellular osmolarity, and a two-component system. This microbial recombinant protein is highly involved in the biochemical reactions, because of its ability to bind with several types of antibodies such as IgG, IgA, IgE, and IgM. So, this microbial protein is used to purify human antibody types. It is having five homologous “Ig” binding domains that fold into three-helix bundles. Each domain is capable of binding to immunoglobulin proteins from many mammalian species most notably with IgG antibodies. Protein A specifically binds to the heavy chain of Fc region of most of the immunoglobulins.

With regard to human VH<sub>3</sub> family proteins, Protein A binds to the Fab region. The recombinant protein A is broader in its ability to bind to other human antibodies (IgA, IgE, IgM) other than IgG antibody. But it is weakly binding with human IgG<sub>3</sub> subclass and it is not binding with IgD human antibody. Protein A also capable of binding to IgG antibodies of other species such as horse, rabbit, mouse, dog, monkey, cow etc.



**Figure 01: Protein A**

Protein A plays a pivotal role in *Staphylococcus aureus* pathogenesis. This protein facilitates the binding of bacteria to the human Von–Willebrand factor coated surface. Thus it is increasing the bacterial infection efficiency. Protein A also cripples the human humoral mediated immunity. This microbial recombinant protein is produced through the industrial fermentation process.

## What is Protein G?

Protein G is defined as the immunoglobulin binding protein that specifically expressed by group C and D streptococcal bacteria. It has high affinity towards the Fc and Fab regions of the antibodies. Protein G has approximately 65kDa molecular size.

Protein G is a surface protein. Because of its binding affinity to immunoglobulins, it is used for antibody purification. Protein G is binding with all subtypes of human IgG antibodies and it is more versatile when binding to IgG antibodies of other species too. But it is not binding to other human antibody types (IgA, IgE, IgM, IgD). The folding of protein G - B1 domains with each other results a globular protein.

# What are the Similarities Between Protein A and Protein G?

- Both are microbial proteins.
- Both are recombinant proteins.
- Both proteins have high affinity towards human IgG antibody and its subclasses.
- Both are used for immunoglobulins purification.
- Both proteins can bind to the Fc region of immunoglobulins.

# What is the Difference Between Protein A and Protein G?

Protein A vs Protein G	
Protein A is defined as a 42 kDa size surface protein which is originally found in the cell wall of <i>Staphylococcus aureus</i> .	Protein G is defined as a 65kDa size surface immunoglobulin binding protein that specifically expressed by group C and D streptococcal bacteria.
Expressing Bacterial Type	
Protein A is expressed by <i>Staphylococcus aureus</i>	Protein G is expressed by group C and D streptococcal bacteria.
Molecular Size	
Protein A has a 42kDa size.	Protein G has approximately 65kDa size (G148 protein G-65kDa and C40 protein G- 58kDa).
Binding to Human Serum Albumin	
Protein A does not bind to serum albumin.	Protein G has binding sites for serum albumin.
Purification of Human IgG <sub>3</sub> Subclass	
Protein A cannot be used for purification of the human IgG <sub>3</sub> subclass as it is not binding to the human IgG <sub>3</sub> subclass immunoglobulin.	Protein G can be used for purification of the human IgG <sub>3</sub> subclass as it is binding to the human IgG <sub>3</sub> subclass immunoglobulin.
Purification of Other Human Antibodies (IgA, IgE and IgM)	
Protein A has a higher ability to bind to other human antibodies other than IgG	Protein G is binding with all subtypes of human IgG antibodies. But protein G is not binding to

antibody. So, it can be used to purify other human antibodies such as; IgA, IgE and IgM.

other human antibodies like; IgA, IgE and IgM. So, it cannot be used to purify other human antibodies such as; IgA, IgE and IgM

## Summary - Protein A vs Protein G

The microbial recombinant protein A, protein G, protein A/G and protein L are native bacterial proteins that have specific binding sites for the Fc region of the mammalian IgG antibodies. Protein A and protein G also have binding sites for the other IgG antibodies of other species. Protein A and protein G are bacterial recombinant proteins which are highly recommended for the purpose of purification of human and other animals' IgG immunoglobulins. Protein L has high affinity towards the kappa light chains of immunoglobulin classes IgG, IgA, and IgM. So, protein L can be incorporated to purify these immunoglobulin types in humans and other species. Industrially all these bacterial proteins are using currently to purify immunoglobulins like; IgG, IgA, IgD, IgE, and IgM. This can be described as the difference between Protein A and Protein G.

### Reference:

1. "Protein A." Wikipedia, Wikimedia Foundation, 26 Dec. 2017. [Available here](#)
2. "Protein G." Wikipedia, Wikimedia Foundation, 16 Dec. 2017. [Available here](#)

### Image Courtesy:

1. 'Protein A 1DEE 1L6X' By E A S - Own work, [\(CC BY-SA 3.0\)](#) via [Commons Wikimedia](#)

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