The Effect of Sulfitolysis on the Allergenicity of Egg White Protein

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Summary

An allergy is an overreaction of the immune system to a normally harmless substance called an allergen. In this study a chemical additive, sodium sulfite (Na_2SO_3), is considered in an attempt to improve digestibility and reduce egg white protein (EWP) allergenicity by protein modification.

Background

An allergic reaction to a food is in fact an allergic reaction to individual food components, mainly proteins. Studies confirm the major egg allergens originate primarily from egg white proteins; these include ovomucoid (OVM), ovalbumin (OVA), ovotransferrin (OTf), and lysozyme (HEWL). Table 1 depicts the select properties of proteins of interest. Increasing research into characterizing the protein allergens has led to a great interest of food manufacturers to develop hypoallergenic food products without compromising the beneficial properties of the food. Treating disulfide bonds (S-S) in proteins with sodium sulfite (Na_2SO_3) cleaves S-S bonds producing approximately equimolar amount of free thiols (-SH) and thiosulfates (S-sulfonic acid, -S-SO_3H), a process known as sulfitolysis, depicted in reaction 1.

$$\mathbf{RSSR + Na_2SO_3 \rightarrow RSH + RS\text{-}SO_3H}$$

Reaction 1. Sulfitolysis

Cleaving the proteins would affect the hydrophobicity character of the protein surface and the introduction of the SO_3 - groups would increase the negative charge of the protein and thus may improve the digestibility/ solubility characteristics and perhaps reduce the allergenicity.

Table 1. Proteins of interest

Protein	Protein Content (%)	Allergenic activity	No. of Disulfide Bridges
OVA	54	++	1
OTf	13	+	15
OVM	11	+++	3
HEWL	3.4	++	4

Objective

To investigate whether treating egg white proteins with different concentrations of Na_2SO_3 would improve the digestibility, and thus reduce the allergenicity of egg white proteins in the process.

Methodology

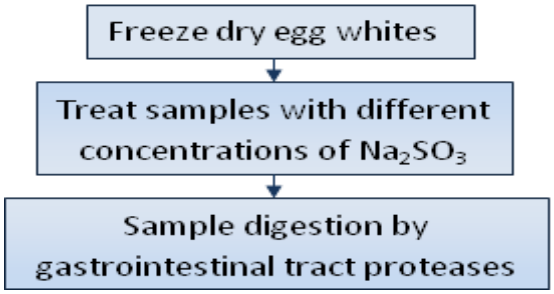

Figure 1. Experimental design

Further, protein aliquots are withdrawn pre- and post-enzymatic digestion and various analyses are carried out to understand the effect of the salt concentrations.

Analysis

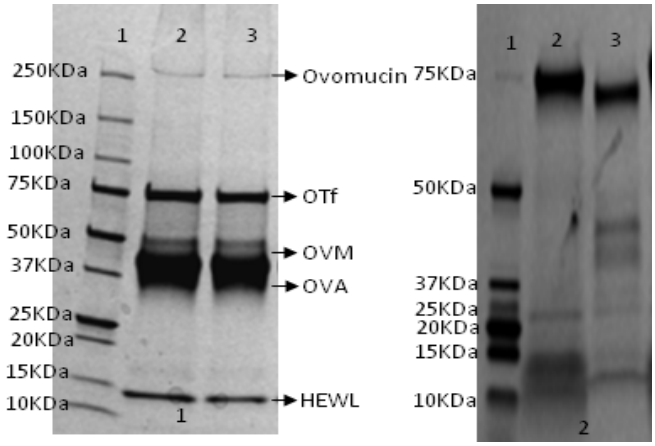

Figure 2. The SDS-PAGE pattern.
Gel 1: Protein pattern produced pre-digestion, lane 1 = standard molecular weight protein marker; lane 2&3 = untreated EWP (control). Gel 2: Digestive enzymes cleave specific peptide bonds within proteins, producing polypeptide fragments. The gel depicts patterns of proteins and peptides produced post-digestion. Lane 1 = standard molecular weight peptide marker; lane 2= EWP post pepsin digestion; lane 3 = EWP post- pepsin/pancreatin digestion.

More investigative studies are necessary to investigate whether this method can be adapted to industrial scale for sulfonation of egg white protein to improve digestibility and reduce allergenicity.

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