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NEOPRO® EW and NEOPRO® HEW EGG WHITE PROTEINS Part I

Egg White Protein (EWP) has been the subject of extensive research in the food and nutrition sciences. In food systems, egg white proteins are recognized for superior binding, air entrapment (foaming) and emulsification properties. Egg proteins and egg protein fractions have been used in personal care products for years. In hair care they have been used as intensive conditioning treatments and, in skin care, as conditioning agents to help moisturize and enhance skin texture and feel.

Egg White Protein is actually comprised of a series of high molecular weight proteins containing a significant number of sulfhydryl and disulfide bonds (See Table 1). The molecular weights of these proteins range from 12,000 to 8,000,000 daltons. The proteins comprising egg white have functionalities and specificities as widespread as their molecular weights and can be especially beneficial in cosmetics and toiletries.

PROTEINS in EGG WHITE

		FUNCTIONALITY
Ovalbumin	54 %	glycoprotein, 4 sulfhydryls, 1 disulfide bond
Ovotransferin	12 %	binds metal ions, anti-bacterial
Ovomucoid	11 %	trypsin inhibitor, 3 disulfide bonds
Ovomucin	3.5 %	viscosity, disulfide bonds
Lysozyme	3.4 %	bactericide, 4 disulfide bonds
G_2-Globulin	4.0 %	
G_3-Globulin	4.0 %	
Ovoinhibitor	1.5 %	protease inhibitor, elastase inhibitor

Ficin Inhibitor, Ovoglycoprotein, Ovoflavoprotein, Ovomacroglobulin, Avidin

From: Developments in Food Proteins - 6 Edited by B.J.F. Hudson

TABLE 1

Ovalbumin, the predominant protein in egg white, contains four sulfhydryl groups and one disulfide group. Ovatransferin complexes iron and copper, metallic elements that can affect the stability of cosmetic systems. Ovotransferin can inhibit free radical formation by scavenging free iron and copper, thereby preventing oxidation processes. Since many microorganisms require iron for growth, ovotransferin has significant anti-bacterial potential. Ovomucoid, a trypsin inhibitor, is a single polypeptide with three separate domains cross-linked by three disulfide bonds. Ovomucin is a mucoprotein and glycoprotein that maintains gel structure and viscosity to the thick albumen fraction of egg white. The extended protein chains of ovomucin are also held together by disulfide bonds. Lysozyme, another egg white component containing disulfide bonds, has powerful bacteriolytic properties and is also found in human tears. Pure lysozyme has interesting clinical applications for treatment of ulcers and infections. Ovoinhibitor inhibits serine proteases and is specifically an inhibitor of elastase. The significance of this property in skin care applications was discussed by Voegeli et al. In an article entitled Elastase and Tryptase

Determination On Human Skin Surface published in COSMETICS AND TOILETRIES (July, 1996), they concluded that topical application of inhibitors of non-specific proteases such as tryptase and elastase can help mitigate UV-irritated skin and dry skin. The incorporation of Egg White Protein (EWP) with its anti-tryptase/elastase activity, would be a novel concept for the next generation of "treatment-type" moisturizers, sunscreen lotions and after-sun balms.

AMINO ACID PROFILE OF EGG WHITE PROTEIN (EWP)

A comparison of amino acid profiles of various proteins is presented in Table 2. Comparing EWP with Collagen protein indicates there are major differences in concentrations for twelve of the nineteen amino acids. When comparing EWP to Wheat protein, there are only three major differences in amino acid distribution. However, when compared to Soy protein, there are no major differences in amino acid distribution. This would suggest that the functionality and performance of EWP would be similar to that of Soy protein. It should be noted that EWP, in contrast with either Soy or Wheat protein, contains a significant quantity of the sulfur-containing amino acids cystine and methionine. These two amino acids, particularly cystine, can interact with the hair via disulfide interchange, essentially building the protein into the hair for enhanced conditioning.

AMINO ACID PROFILE

(Values as g/100g protein)	Egg White	Collagen	Wheat	Soy
Alanine	5.85	**11.30**	2.71	4.18
Arginine	5.51	8.90	3.22	7.47
Aspartic Acid	10.31	6.60	**3.28**	11.90
Cystine	2.62	0	2.25	1.21
Glutamic Acid	13.46	11.40	**40.20**	19.61
Glycine	3.55	**27.60**	3.41	4.12
Histidine	2.29	**0.76**	2.33	2.87
Hydroxyproline	0	**14.40**	0	0
Isoleucine	5.72	**1.70**	4.43	4.90
Leucine	8.55	**3.36**	7.43	8.01
Lysine	6.90	5.74	1.53	6.17
Methionine	3.49	**0.82**	1.72	1.20
Phenylalanine	5.92	**2.33**	5.56	5.09
Proline	3.94	**16.50**	**14.19**	5.31
Serine	6.99	4.15	5.33	5.09
Threonine	4.60	2.27	2.73	3.43
Tryptophan	1.25	**0**	1.08	1.07
Tyrosine	3.94	**0.23**	3.93	3.22
Valine	6.45	**2.63**	4.56	5.28

TABLE 2

Amino acids can be categorized several ways, by chain configuration, hydrophobicity or hydrophilicty, or by ionic charge. Amino acids with aliphatic and aromatic side chains have limited solubility and, as such, are not major contributors to overall protein charge. The polar amino acids are readily soluble in water, where they exist as either a charged or uncharged molecule. Defining a protein in terms of the charge of its component amino acids is used to predict the net charge of a protein. This is most important when considering the substantivity of a protein to

AMINO ACID TYPES

(Values as g/100g protein)	Egg White	Collagen	Wheat	Soy
Hydrophobic (side chains)				
Aliphatic	34.00	36.31	35.04	28.88
Aromatic	11.11	2.56	10.57	9.38
Hydrophilic (side chains)				
Charged	38.47	33.40	50.56	48.02
Uncharged	14.21	6.42	10.31	9.73
Basic	12.41	14.64	4.75	13.64
Slightly Basic	2.29	0.76	2.33	2.87
Acidic	23.77	18.00	45.81	34.38
Net Charge	- 9.05	- 2.60	- 38.73	- 17.87

From: Food Chemistry by Owen Fennema

TABLE 3

surfaces such as hair or skin. The less negative the protein charge is, the less repulsion there will be to the hair or skin which naturally carry a negative charge. From Table 3, it can be seen that Collagen and Egg White Protein carry significantly lower net negative charges than either Soy or Wheat protein. Therefore, EWP and Collagen would experience less electrostatic repulsion by hair or skin and would exhibit greater substantivity.

NEOPRO® HEW - HYDROLYZED EGG WHITE

NEOPRO® HEW is an edible enzymatic hydrolysate of natural egg white with an average molecular weight of 1,200 daltons. **NEOPRO® HEW** is a water-dispersible ivory to off-white free flowing powder. It is dispersible in commonly used surfactants and in 50% ethanol. It is heat stable, retaining its functional properties at temperatures up to 85°C.

NEOPRO® HEW can help to build viscosity without affecting foam production. In fact, **NEOPRO® HEW** may help to improve the lathering characteristics of shampoos. As an ingredient for use in cosmetics and toiletries, **NEOPRO® HEW** has film-forming properties similar to other hydrolyzed proteins. As a result, in hair care products, **NEOPRO® HEW** can help to repair split ends, restore luster and build body. In skin care systems, **NEOPRO® HEW** helps to moisturize and improve skin texture.

ALCOHOL SOLUBILITY

Water : SDA39C	NEOPRO® EW @ 5.0%	NEOPRO® HEW @ 5.0%
100%	d	d
75% : 25%	i	d
50% : 50%	i	d
25% : 75%	i	i
100%	i	I

d = dispersible i = insoluble

TABLE 4

NEOPRO® EW - EGG WHITE

NEOPRO® EW is an off-white spray dried edible form of pure egg white. NEOPRO® EW has an average molecular weight of 43,000 daltons and consists of an array of functional protein fractions including ovalbumin, ovotransferin and lysozyme. NEOPRO® EW is dispersible in water and surfactants. In shampoo systems, NEOPRO® EW builds viscosity and boosts foaming. In skin cleansers and body washes NEOPRO® EW can help to

SURFACTANT SOLUBILITY

	NEOPRO® EW @ 5.0%	NEOPRO® HEW @ 5.0%
TEALS	d	s
SLES2	d	d
ALS	d	d
CAB	d	d

s = soluble d = dispersible

TABLE 5

improve lather while imparting a smooth after feel to the skin. In rinse-off and leave-on hair products, NEOPRO® EWs film forming properties help to impart shine and body to the hair. NEOPRO® EW can restore damaged hair, mending split ends and smoothing the cuticle. In skin care, especially for facials, egg white is known to tone the skin, improving texture.

VISCOSITY EFFECTS

The effects of NEOPRO® HEW on surfactant viscosity was determined for triethanolamine lauryl sulfate (TEALS), sodium lauryl ether sulfate - 2 moles (SLES-2), ammonium lauryl sulfate (ALS) and cocoamidopropyl betaine (CAB). The results are presented in Figure 1. The graph presents viscosity values and the percent increase for each of the surfactants with 5% (w/w) NEOPRO® HEW.

The addition of 5% (w/w) NEOPRO® EW had a significantly greater effect on surfactant viscosity (Figure 2). With this protein, the percent increase ranged from 250% to greater than 158,000%, and the addition of just 2.5% (w/w) NEOPRO® EW increased viscosity by 1,960%!

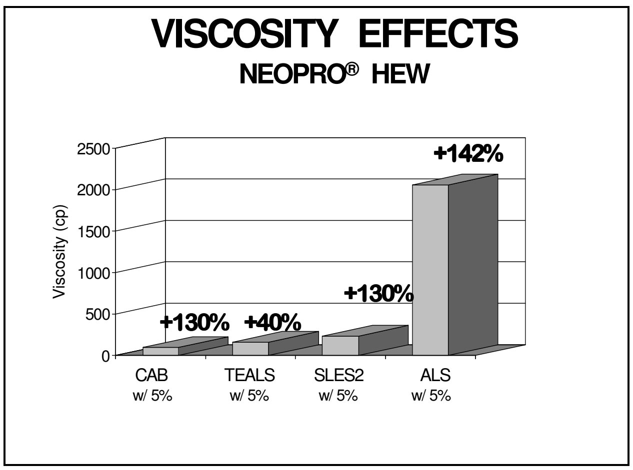


TABLE 1

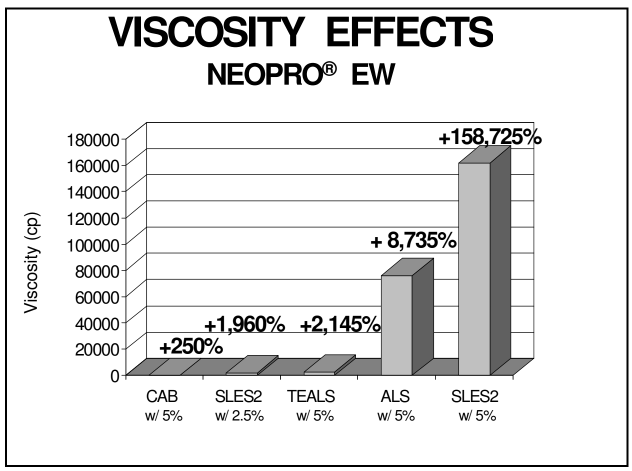


TABLE 2

A concentration versus viscosity curve was determined for NEOPRO® EW in SLES-2. Even with the addition of 1% (w/w), the increase in viscosity is 85% (Figure 3). Figure 4 shows the effects of Egg White Protein on the viscosity of a purchased shampoo. As the graph indicates, the addition of 5% (w/w) NEOPRO® EW resulted in an increase of 50%! Thus, it appears that NEOPRO® EW can increase viscosity in the presence of other components in the product formulation.

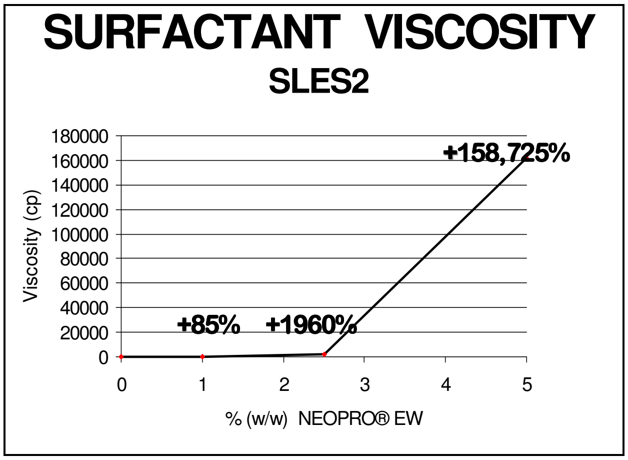


TABLE 3

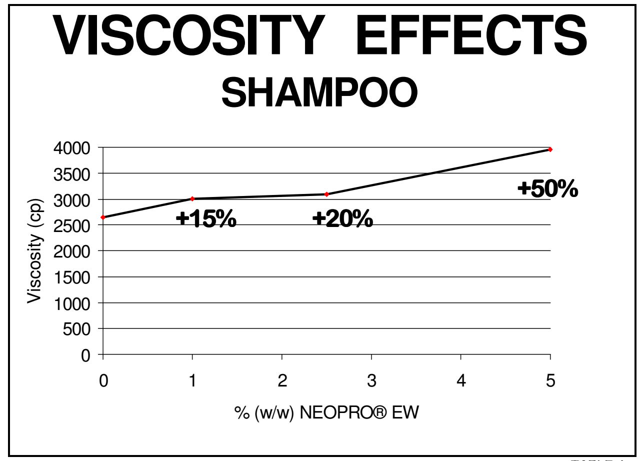


TABLE 4

EFFECT ON FOAM VOLUME

When 5% (w/w) of either NEOPRO® EW or HEW was added to various surfactants, foam volume both increased and decreased (Figure 5). The effect of NEOPRO® EW on foam volume of the purchased shampoo was also determined. Figure 6 illustrates that Egg White Protein does increase the foam volume of this shampoo by as much as 60%! It should be noted that, subjectively, foam production and lathering ability were perceived to be enhanced, though no quantitative measurements were made of foam density.

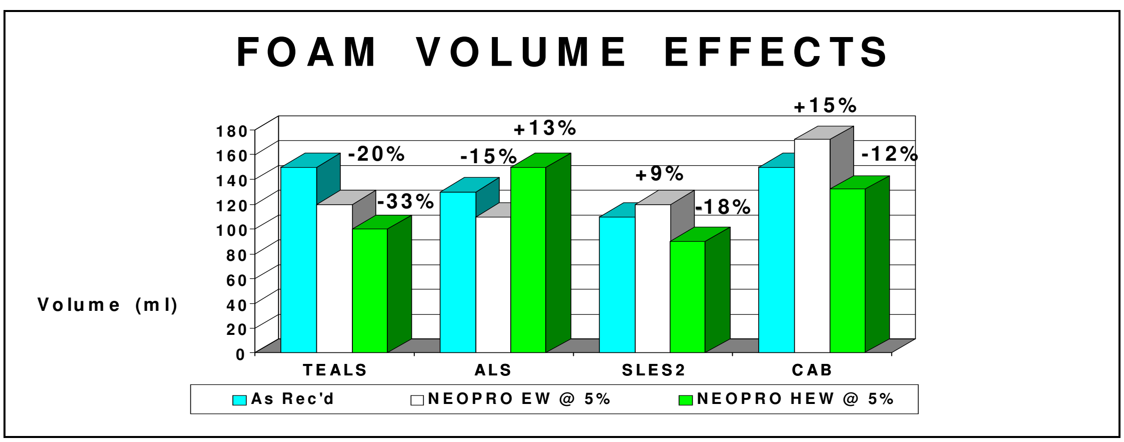
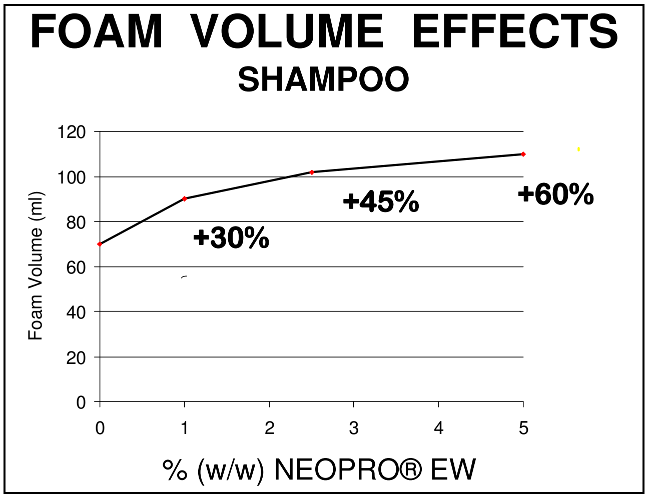


FIGURE 5



SUMMARY

Egg White Proteins are truly multi-functional materials. The high MW form (NEOPRO® EW) consists of an array of protein fractions that can contribute to the overall health and appearance of skin and hair. Egg White Proteins are water and surfactant dispersible and can modify viscosity and foam production. The effects of NEOPRO® EW and HEW on humectancy, tensile strength and hair substantivitity will be presented in a future PHOENomenon product newsletter from PHOENIX CHEMICAL INC.

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