

Effect of Dilution and Leaching Temperature on Extractable Protein Content in Natural Rubber Latex Gloves

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Introduction

Natural rubber latex is an invaluable raw material in the present world. There are number of products made out of natural rubber latex as it has valuable properties like high tensile strength and elasticity. Natural rubber products are two different types as dry rubber products and latex based products. The synthetic rubber products have come in to the market of rubber product designing and it competes with natural rubber products. The major problem associated with natural rubber latex products is the 'type I allergy' caused by the proteins leached from the sweat or other body fluids (Parra, 2005). The reason is proteins present in natural rubber latex. The main aim of this study was to introduce two alternative methods to tackle the protein allergy in natural rubber products. Acid treatments, potassium hydroxide treatments and addition of water soluble polymers as strategies have been already introduced to reduce extractable proteins in natural rubber products. In this study, the effect of dilution and leaching temperature increment was investigated as another two methods to reduce the extractable proteins in the natural rubber products.

Methodology

Study was carried out at Lalan Rubbers (Pvt) Ltd, Horagasmankada, Warakapola. Protein testing and other laboratory analyses were conducted at central laboratory, Biyagama and latex laboratory, Warakapola. Two strategies were investigated by two different experiments. Under the dilution strategy, two treatments were applied with a control. Complete randomized design was conducted for the experimental design. Nine latex batches were collected and one treatment was applied for three latex batches and three were kept as the control. Three was diluted to 30% of dry rubber content and another three for 25% dry rubber content, remaining three kept in its original dry rubber content. Latex films were prepared after diluting of batches as five films. All batches were centrifuged separately and latex films were prepared. Centrifuged latex was compounded and then glove films were prepared. Protein testing was carried out using modified Lowry method using micro plate reader. Under leaching treatment one latex batch were selected and gloves were prepared. Temperature of the leaching tanks was changed to 50 °C and from 50 till 90 °C, in each 10 °C interval 10 gloves were stripped with control. Collected gloves were subjected to protein analysis using modified Lowry method. Tensile strength of the gloves was also tested using tensometer to check the treatments effects to the tensile property of the gloves . Dilution data were analyzed separately as protein contents in field latex, centrifuged latex and the gloves. The protein data were analyzed using analysis of variance (ANOVA) in Minitab 16 software.

Results and Discussion

The average protein contents in each treatment and the statistical value in each occasion are shown in table 1. Results revealed that, there was no significance difference ($p=0.060$) between three treatments for the field latex. Though the dilution was done in field latex, extractable

proteins were not removed due to dilution. In centrifuged latex, there was a significant difference ($p=0.000$) between three treatments and the highest mean value was recorded in control sample and the lowest mean was recorded in 25% dry rubber contained latex. However the extractable protein contents reduced with the increase of dilution in the latex. In gloves there was a significance difference ($P=0.000$) between means of three treatments and the highest mean was recorded in control sample while lowest mean in 25% dry rubber contained gloves. It was clear that the protein content reduced with the dilution.

Table 1. Average protein content ($\mu\text{g/g}$) in field latex, centrifuged latex and gloves.

	Field latex			Centrifuged latex			Gloves		
	T 1	T2	T3	T1	T2	T3	T1	T2	T3
Average protein content	402.29	403.16	401.30	120.62	95.27	85.73	171.03	165.07	143.42
P value		0.060			0.000			0.000	

Average protein contents at different temperatures are presented in table 2. There was a significant difference ($P<0.05$) between the means of the samples. Average protein contents reduced with the temperature increment. Similar to the present study, the extractable proteins reduced due to hydrolysis of high molecular weight proteins in leaching as a property tensile strength was tested in gloves (Maznah, 2008)

Table 2. Average protein content in leaching treatments at different.

	50°C	60°C	70°C	80°C	90°C
Average protein content	282.950	272.351	258.189	225.707	204.045
P value	0.000				

Average tensile results are presented in Table 3. According to the American Society for Testing and Materials (ASTM) standards tensile strengths were in acceptable limits.

Table 3. Tensile strength of three samples.

Treatment 1	Treatment 2	Treatment 3
12.519	14.668	16.318

Conclusions

Dilution of natural rubber latex and increasing leaching temperature reduced the extractable protein content of natural rubber latex films. Therefore there is an effect of dilution and leaching temperature on protein content in natural rubber latex.

Reference

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- Maznah, K.S., Baharin, A., Hanafi, I., Azhar, M.E., Hakim, M.H.M.R., 2008. Effect of soaking in potassium hydroxide solution on the curing, tensile properties and extractable protein content of natural rubber latex films. *Polymer testing*, 27(8), 1013-1016.