

**Pre-evaluation of antiviral activity
of Meryl® fabrics**
Quantification of silver by ICPMS

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Determination of the silver content for pre-evaluation of the antiviral resistance of Meryl® Skinlife yarns

1. Introduction

NYLSTAR manufactures several grades of yarns branded as Meryl Skinlife Force® 2.0, 2.01 y 2.02 with a silver nanoparticle based technology that are believed to confer antimicrobial resistance to i.e. E.Coli and antiviral activity to H1N1 virus type, according to recently published studies ^{1,2,3}.

LEITAT has performed quantification of silver content in Meryl® fabrics produced with the different grades of Meryl® yarns by ICPMS (Inductively coupled plasma mass spectrometry) and determined the optimum concentration of silver nanoparticles in Meryl® fabrics with capabilities for inducing antimicrobial and antiviral resistance in accordance to recent studies.

2. Experimental part

2.1. Technique used for silver determination and quantification (Ag)

ICPMS was used for determination and quantification of silver content (Ag) in polyamide Meryl® fabrics.

2.2. Equipment.

- Microwave Equipment CEM

A microwave system was used for digestion of Meryl samples, so that is, dissolution of the polyamide fraction and recovery of the metal residue (Ag) for its subsequent analysis.

- ICPMS Agilent 7500

An ICPMS was used for determination and quantification of silver content (Ag) in Meryl samples.

2.3. Experimental procedure.

Samples were treated as follows: 0.5 grams of Meryl fabric were weighted and digested in 10 mL of nitric acid (HNO₃ 70% from Scharlau) in an analytical microwave at 230 °C. After dissolution of the polyamide

¹ Y. Mori, T. Ono, T. Miyahira, V.Q. Nguyen, T. Matsui and M. Ishihara. Antiviral activity of silver nanoparticle/chitosan composites against H1N1 influenza A virus. *Nanoscale Research Letters*, **2013**, 8, 93.

² M. Ishihara, V.Q. Nguyen, Y. Mori, S. Nakamura and H. Hattori. Adsorption of silver nanoparticles onto different Surface structures of chitin/chitosan and correlations with antimicrobial activities. *Int. J. Mol. Sci.* **2015**, 16, 13973-13988.

³ S. Nakamura, M. Sato, Y. Sato, T. Takayama, M. Fujita and M. Ishihara. Synthesis and application of silver nanoparticles (Ag NPs) for the prevention of infection in healthcare workers. *Int. J. Mol. Sci.* **2019**, 20, 3620.

fraction, the resultant residue was diluted and analysed by ICPMS for determination and quantification of silver content (Ag).

2.4. Samples

NYLSTAR provided three Meryl® fabrics that were manufactured with three different grades of Meryl® Hydrogen Skinlife Force yarns with different antimicrobial and antiviral resistance conferring properties. Nomenclature is detailed as follows:

- 44f/48 Meryl Hydrogen Skinlife Force 2.0
- 44f/48 Meryl Hydrogen Skinlife Force 2.1
- 44f/48 Meryl Hydrogen Skinlife Force 2.2

3. Results

Table 1 collects data of silver content (AgNPs $\mu\text{g}/\text{cm}^3$) of Meryl® fabrics manufactured with the different grades of Meryl® yarns, 2.0, 2.01 and 2.02 that NYLSTAR manufactures. These results indicate a silver content of 6 - 10 $\mu\text{g}/\text{cm}^3$ depending on the degree of yarn used. Recent studies ^{1,2,3} have demonstrated that the presence of silver nanoparticles within a range content of 2,3 – 8,5 $\mu\text{g}/\text{cm}^3$ confers antimicrobial and antiviral activity due to the capacity to provoke a reduction in the viability and infectiveness of the microorganisms tested (see Table 2). Concentrations of silver within the cited range have the capacity to produce a reduction of 0.9 – 5.7 and 0.2 – 2.2 logarithmic units, respectively. The different tested grades of Meryl® yarns contain silver nanoparticles in the range of 6 a 10 $\mu\text{g}/\text{cm}^3$ which would imply a reduction in the viability of 3,8 – 5,7 logarithmic units for E.Coli and a reduction of the infectiveness of 2.0 – 2.2 logarithmic units for Influenza AH1N1 virus. According to normative “ISO 18184: 2019 – Determination of antiviral activity in textile products”, values of infection reduction equal or above to 2.0 logarithm are considered to be significative and categorized as “Good antiviral effect”.

Table 1. Silver content values obtained for Meryl fabrics obtained with the different grades of Meryl® yarns.

Fabric samples	AgNPs ($\mu\text{g}/\text{cm}^3$) Meryl® fabric*
44f/48 Meryl Hydrogen Skinlife Force® 2.0	6.11
44f/48 Meryl Hydrogen Skinlife Force® 2.01	7.21
44f/48 Meryl Hydrogen Skinlife Force® 2.02	10.79

*Values obtained by ICPMS.

Table 2. Concentration range of silver nanoparticles (AgNPs) with capacity to confer antimicrobial y antiviral activities ^{1,2,3}.

AgNPs ($\mu\text{g}/\text{cm}^3$ CNFS)	Antimicrobial activity (E. coli)		Antiviral activity (H1N1)	
	Log 10CFU/ml	Log. Reduction	Log 10TCID50	Log. Reduction
Control	5.74	-	6.2	-
0	4.83	0.9	5.96	0.2
2.3	3.14	2.6	4.33	1.9
3.8	1.96	3.8	4.19	2.0
8.5	0.00	5.7	3.98	2.2

4. Recommendations

Based on the results obtained of silver content of the different grades of Meryl Skinlife Force® yarns the following recommendations are made for conferring antimicrobial and antiviral activities to high technical fabrics:

- ✓ Meryl Skinlife Force® 2.0, 2.01 and 2.02 have a content range of 6 a 10 µg/cm³ of silver nanoparticles technology which would imply a reduction in the viability of 3,8 – 5,7 logarithmic units for E.Coli and a reduction of the infectiveness of 2.0 – 2.2 logarithmic units for Influenza AH1N1 virus based on studies^{1,2,3} . This viability and infectiveness reduction capacity is categorised as “Good antiviral conferring effect” according to normative “ISO 18184: 2019 -Determination of antiviral activity in textile products”.
- ✓ It is therefore highly recommended the use Meryl Skinlife Force® grades yarns 2.0, 2.01 and 2.02 in the manufacturing of high technical and protective fabrics due to their potential to reduce viability and infectiveness of microbes and virus.