



Evaluation of the use and re-use of cotton fabrics as medical and hospital articles wraps in steam sterilization method.

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Introduction: In Brazilian health facilities, double cotton wraps are used in a large scale for packaging medical and hospital articles when steam sterilization is used, but little is know about their efficacy as microbial barriers. The **objective** of this study was to verify the efficacy of cotton fabric, made of serge bonding 2 x 1 (new double 100% cotton fabric wrappers with second characteristics and technical specifications were used: **thickness**- 0,40mm \pm 0,05%; **weight** 210g/m² \pm 0,05%; **resistance to traction** - 12,5 daN/cm in warp and 5,5 in fill), complying with Brazilian standards for the manufacturing of double cotton wraps as an efficient microbial barrier, while still new and after multiple laundering and steam sterilization procedures and to correlate the power of the microbial barrier with physical characteristics alterations in the fabric as to its weight, tearing, traction and

stretching along the warp and fill fabric direction. **Materials and Methods:** Standard test methods were used in both the evaluation of the physical characteristics (NBR 17.006/88 for weight, American Society for Testing and Materials-ASTM 5.034/75 for traction and stretching resistance) and Deutsches Institut für Normung - DIN 53.861/78 for tearing resistance and microbiological characteristics (DIN 58.953/87).

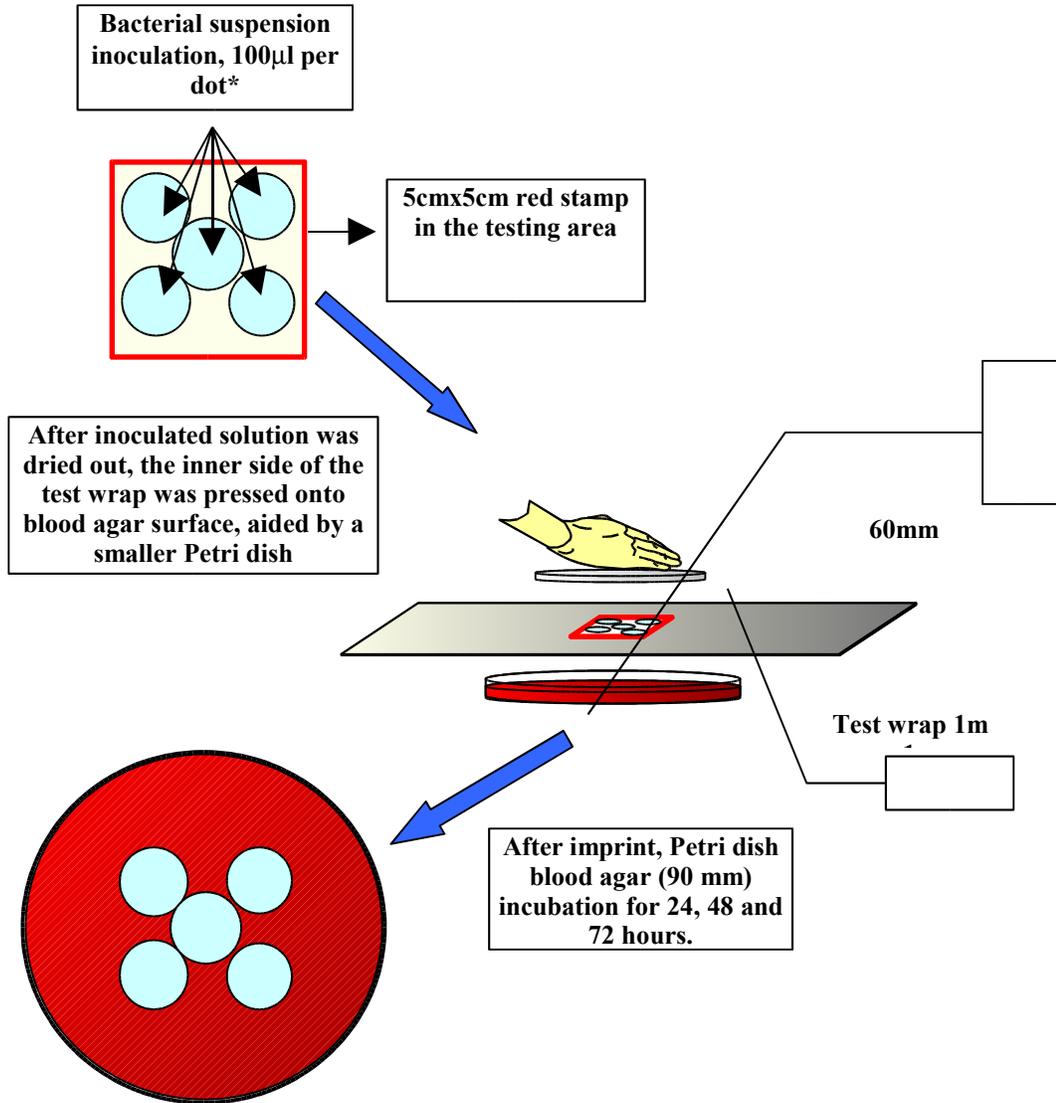
The sample was constituted of 120 wraps for the wearing out, microbiological and physical tests. Each wrap received an alphanumeric sequential identification with indelible paint. After each laundering and steam sterilization cycle, the reprocessing number was registered on the fabric, correspondingly and in a sequence: R1, R2, R3, etc.

Stage 1 - Each wrap tested was used as an external wrapper of surgical drapes in order to undergo handling tension. Next, they were submitted to steam sterilization and later removed from the package and sent to the laundry to be processed as hard color cotton attire, using only stabilized hydrogen peroxide as bleacher in the washing procedure. This set of procedures was defined as wearing out simulation.

Stage 2 - Microbiological testing for efficacy as a microbial barrier was held in the Laboratory for Medical Investigation in Bacteriology of the Hospital das Clínicas, Faculty of Medicine, University of São Paulo. In order to verify the efficacy of the wrap as a microbial barrier the German methodology Deutsches Institut für Normung (DIN) 58.953/87, part 6 was used - a test to detect micro-organisms when specimen are subjected to humidity.¹⁴ Microbiological tests were done by infusing 100µl of testing microorganism solution- *Staphylococcus aureus* ATCC 25.923 on the wraps and microorganism strike-through was evaluated after laminar flow drying. A lower growth to 5 colony-forming units (CFU) was considered negative according to methodology DIN 58.953/87.

A working diagram for the bacterial barrier tests is presented on Figure 1.

Figure 1 - Microbiological experiments diagram for barrier test.



* 10^7 a 10^8 CFU/ml Bacterial suspension of *Staphylococcus aureus* ATCC 25923

Stage 3 - In order to correlate the timing of microbial barrier breaking to the physical wearing of the fabric, official methods were used for physical tests: weight determination according to NBR 17.006/88⁴; tearing resistance according to DIN 53.861/78¹³ and traction and stretching resistance according to Grab's test¹ (American Society for Testing and Materials Method - ASTM D 5.034/95).

RESULTS: The results of the microbiological tests evidenced that test wraps submitted to up to 65 reprocessing procedures performed effectively as a microbial barrier. Out of a total of 55 samples used in the microbiological test, 6 (11%) presented over 5 CFU growth in the reprocessed wraps R70 and R75 and 49 samples (89%) remained negative according to criteria established by DIN (No growth or growth lower than 5 CFU).

Table 1 shows the results of the microbiological study.

Table 1- Frequency of microbiological growth for the 55 test wraps, according to various reprocessing methods employed.

Culture	Reprocessing Cycles (R)											TOTAL (%)
	1	25	30	35	40	45	50	55	65	70	75	
No Growth (-)	5	5	5	5	5	5	5	5	5	1	1	47 (85)
Growth < than 5 CFU (-)*	0	0	0	0	0	0	0	0	0	0	2*	2 (4)
Growth > than 5 CFU (+)	0	0	0	0	0	0	0	0	0	4**	2***	6 (11)
	5	5	5	5	5	5	5	5	5	5	5	55 (100)

* Culture with growth < 5 CFU was considered negative

** 22CFU, 30CFU, 66 CFU, 55 CFU

***6 CFU, 7CFU

The results of the physical testing is presenting in table 2.

Table 2 - Mean values for weight, tearing, traction and stretching of the test wraps by each reprocessing type.

		WEIGHT (g/m ²)	TEARING (kgf/cm ²)	TRACTION (kgf)		STRETCHING (%)	
				Fill	Warp	Fill	Warp
New		416,84	7,11	58,75	28,61	17,30	17,82
	1	427,18	7,06	57,19	30,24	22,78	17,18
REPROCESSING	25	433,04	4,73	45,52	24,12	22,56	14,36
	50	424,07	3,90	35,87	21,82	22,72	14,54
	65	410,22	4,22	32,38	18,53	19,77	13,98
CIRCLES	70	409,26	3,84	31,42	18,97	17,27	12,03
	75	395,48	3,05	24,57	15,05	17,68	11,03

As for the results of the physical testing (Table 2) weight increased until the 25th reprocessing cycle and wraps started to lose mass per area in relation to the new fabric from reprocessing cycle number 65 on wards.

In the tearing test, there was a noticeable decrease in resistance in the first 25 reprocessing procedures whereas the 65th reprocessing cycle presented a 45% loss of initial resistance in the fill direction and 40% in the warp direction. A similar result occurred with the stretching test.

In both national and international available literature, we cannot find studies on the effectiveness of the microbial barrier of cotton wraps used in healthcare facilities for packing steam sterilized hospital articles.

This study aimed to achieve practical results by providing data for guidelines to orient hospital facilities as to the desirable quality of reusable barrier products, of double cotton wraps used in packing hospital articles in repetitive laundering and autoclaving processing.

CONCLUSION: This present study provided the following conclusions:

- 1) The double cotton wraps for packing medical and hospital articles, Brazilian standard, were efficient as a microbial barrier in up to 65 reprocessing procedures (laundering and autoclaving).
- 2) Concerning alterations in the physical characteristics of the double cotton wraps, the decrease of weight seems to be the element to support, theoretically, microbial barrier breaking from the 65th reprocessing cycle onwards. Alterations observed in the other physical measures of tearing, traction and stretching of the warp and fill did not support the likely justification of the microbial barrier efficacy breaking, as the decrease of these values took place in different timings of reprocessing cycles without compromising microbial barrier efficacy.

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