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Comparison between Homemade Stain Remover and Commercial Stain Remover for Textiles

Nur Syaliza Musa, Nor Liyana Abdurahman, Zahirah Zainal Abidin, Farah Hanim Adnan, Eryna Nasir*

School of Industrial Technology, Faculty of Applied Sciences, Universiti Teknologi MARA, Negeri Sembilan Branch, Kuala Pilah Campus, 72000 Kuala Pilah, Negeri Sembilan, Malaysia

**Corresponding author's e-mail: eryna@uitm.edu.my*

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ABSTRACT

Stain remover is used to remove or masks stain from textiles. Two types of textile stain removers were compared in this study; store bought and home prepared types. Due to the environmental and health issues associated with commercial household cleaners, as well as costly, there have been attempts by consumer especially housewives to prepare cleaning products by using materials which can be found in the kitchens. Hence, the main objective of this study is to compare the effectiveness of home prepared textile stain remover with commercial stain remover by assessing the stain properties on cotton and polyester fabrics. Two different brands of stain remover and easily found materials were applied on these two fabrics. The stains on the fabrics were then assessed according to AATCC Test Method 130 and by using chromameter for the intensity of the stain after cleaning. The results showed that, for the cotton fabric, the most effective stain remover is Commercial Brand 1. Commercial Brand 1 and vinegar with baking soda demonstrated an encouraging effect on polyester fabric. The commercial textile stain remover shows great cleaning effect on both cotton and polyester, while home prepared stain remover has limited ability to clean the stains on cotton. However, its cleaning effect on polyester is equivalent to a commercial product.

Keywords: *stain remover, textile care, household product, commercial product, soil release*

INTRODUCTION

Stain is a mark or spot which sometimes is visible from the surface of any material or element it is found. It is categorised into several classes which are enzymatic, oxidisable, greasy, and particulate [1]. People usually choose to combine several chemical applications to remove or mask stains which is called stain remover. Some of the methods involve solvency (dissolving the stain), detergency (putting the stain into suspension), saponification (using the stain to make a water-soluble soap), bleaching reaction (oxidising or reducing the stain to decolourise it) and breaking the molecule apart with specific enzymes. A lot of products even homemade solutions beat stains using various techniques. The primary objective of the invention is to provide a method to remove stains from textiles that minimise the health risk and does not expose the person carrying out the method to any excess health hazard [2].

Commercial stain remover is store bought cleaning products, usually in liquid or powder form. Commercial stain remover usually contains surfactant and hydrogen peroxide. Surfactants in cleaning products allow for the stains to be suspended using phospholipids, a class of lipids (fats) that have a glycerol, hydrophilic (attracted to water) head, and two fatty acid chains that are hydrophobic (repel water), and easily washed away [3]. Generally, surfactant may harm the aquatic animal and aquatic plant. Huge amount of surfactant containing wastewater are discharged into the environment which will affect aquatic life and polluting the water. This chemical substance also can affect human body which it can cause skin irritation and dangerous to the eyes [4]. Taking a simple step like making a home prepared cleaner is the best way to adopt greener cleaning practice. Thus, it can reduce exposure to harmful chemical and help making the planet a safer place to live.

In this project, there are few basic household cleaning ingredients used such as baking soda, lemon juice and vinegar. Dilution with water is suggested for most use of vinegar to ensure safer cleaning and to avoid damage on the surfaces being cleaned. Because it is acidic, it can dissolve mineral deposits from any smooth surfaces [5]. Other acidic material used is such as lemon juice, which can effectively remove stains and its action can be accelerated by exposing the stain to sunlight while soaking [6]. The

cleaning ingredients in this project are formed into two recipes; one is the mixture of vinegar and baking soda and the other one is mixing of lemon juice with water [7]. This formula is created with a very affordable price from the ingredients that are usually available at home. Moreover, this can be an object of invention to provide a stain remover composition that does not leave the textile discoloured after use but also provide another method to remove stain from textiles that is fast and simple [2]. Therefore, this project was conducted to compare the effectiveness of home prepared stain remover with commercial textile stain remover with the determined type of stains used, as well as to identify an alternative that could be potentially used to remove stains in economical ways.

MATERIALS AND METHODS

The research was focused on the method of removing and assessing the determined stains on two types of fabrics; cotton and polyester. Therefore, there were three main activities in this research, where the first one was staining, which was followed by cleaning with different stain removers and next was the evaluation process. The stain removers were commercial and home prepared, and these materials would be compared in terms of stain colour change and the distribution of the stain on the fabrics after cleaning.

Materials

Two types of fabric were used in the scope of the present study. The materials tested include 100% cotton and 100% polyester woven fabrics. Besides that, coffee, engine oil, and food colouring were used as the stain. Two different brands of textile stain removers were bought from the store with a price of RM15.95/litre for Commercial Brand 1 and RM8.45/litre for Commercial Brand 2, while home prepared stain removers were derived from vinegar, baking soda, and lemon.

For cotton and polyester samples, the fabrics were cut into 8cm x 8cm and 14cm x 13cm respectively as shown in Figure 1(a) and Figure 1(b). A 5cm diameter circle was drawn in the centre of both samples. The sample size for polyester was larger than cotton sample to prevent the stain from covering the whole polyester surface. This is because, stains on polyestersample tend to spread easily to a larger part of the sample. The uncovered area is needed to distinguish between stained and unstained fabric area.

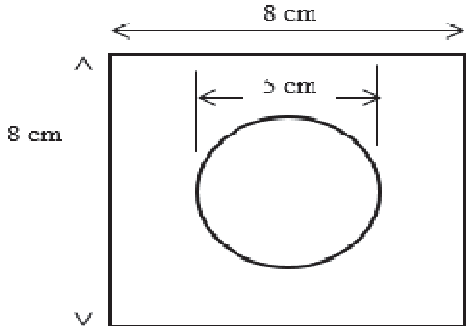

Figure 1 (a): Cotton Sample

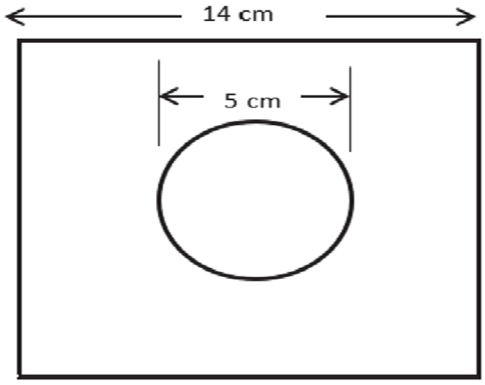

Figure 1 (b): Polyester Sample

Staining and Cleaning Procedure

All the fabrics in staining and cleaning procedures need to be washed before the experiment was conducted. This was to remove all the impurities and the stains that were bound on the surface of the fabrics. This could help the authors to get better results in the staining and washing process.

Staining

A few drops of stains were applied right in the middle of the circle on the fabric with the aid of a dropper and tiles at the bottom as depicted in Figure 2. The fabric samples need to be stained with the selected soils that were prepared comprising coffee (liquid), engine oil and liquid food colouring. The amount of stains applied on the fabric samples was fixed for each type of stains used. The coffee mixture was prepared by diluting 150g of coffee powder in 100ml of water. As the stain spreading and approaching the circle line, the dropping of the soil was stopped. Next, the test samples were kept for 24 hours before cleaning with textile stain removers to allow

complete absorption of the soils into the fabric. This procedure was adapted from American Society for Testing and Materials, ASTM International D4265 – 14, Standard Guide for Evaluating Stain Removal Performance in Home Laundering [8].

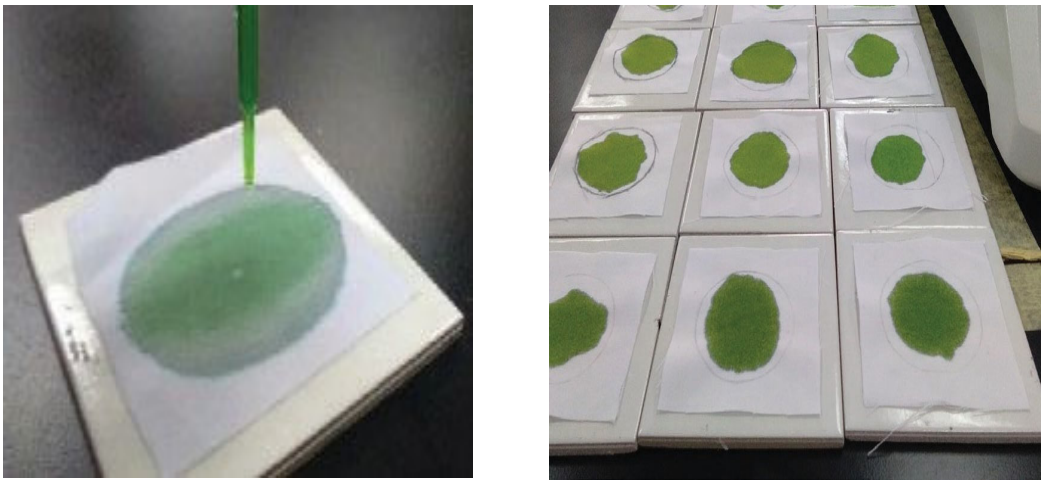

Figure 2: Fabric Staining

Stain Removing

Table 1 shows the method of stain removers' application on the fabric samples. Overall, the stain removers were applied by rubbing them evenly right on the stains. The fabrics were left for five minutes before washing took place. For the preparation of washing, all of the fabric swatches were sewn on other wide fabric or garments following the procedure standard of American Association of Textile Chemists and Colorists (AATCC). The load of 5kg of fabric swatches and other garments were washed by using self-coin operated washing machine with standard detergent for 30 minutes. The swatches were then line dried.

Table 1: Stain Removers Application

No	Fabric Type	Stain Remover	Sample Name	Amount of Stain Remover	Method of Application
1	Cotton	Without stain remove	CX	-	Wash by using plain water
2	Cotton	Commercial Brand 1 Commercial Brand 1	CV	4ml	Rubbing evenly on stain
3	Cotton	Commercial Brand 2	CC	4ml	Rubbing evenly on stain
4	Cotton	Lemon	CL	5ml	Rubbing evenly on stain
5	Cotton	Vinegar + Baking soda	CV-BS	5ml vinegar, 1g baking soda	Rubbing of vinegar and adding of baking soda
6	Polyester	Without stain remove	PX	-	Wash by using plain water
7	Polyester	Commercial Brand 1	PV	4ml	Rubbing evenly on stain
8	Polyester	Commercial Brand 2	PC	4ml	Rubbing evenly on stain
9	Polyester	Lemon	PL	5ml	Rubbing evenly on stain
10	Polyester	Vinegar + Baking soda	PV-BS	5ml vinegar, 1g baking soda	Rubbing of vinegar and adding of baking soda

Staining Evaluation

Figure 3 and 4 show the equipment used to assess the stain on the tested samples. Two criteria evaluated were stain colour intensity by using chromameter and stain visibility which was examined under lighter cabinet based on rating.

Figure 3: Chromameter

Figure 4: Lighting Cabinet

Chromameter was used to see the colour differences between the fabric samples before cleaning and after cleaning. Colour difference can be defined as the numerical comparison of a sample's colour to the standard. Each of the samples were identified with their colour differences using L*a*b* coordinates. L* indicates the lightness, a* is the red/green coordinate, and b* is the yellow/blue coordinate. For stain visibility, five persons were required to evaluate and determine the fabric samples based on the AATCC Test Method 130 - standard for stain release replica [9]. The samples were observed under light source of D65 and graded based on rating in Table 2 and reference in Figure 5.

Table 2: Stain Release Rating

Rating	Description
1	Residual stain equivalent to Replica 1
2	Residual stain equivalent to Replica 2
3	Residual stain equivalent to Replica 3
4	Residual stain equivalent to Replica 4
5	No residue stain

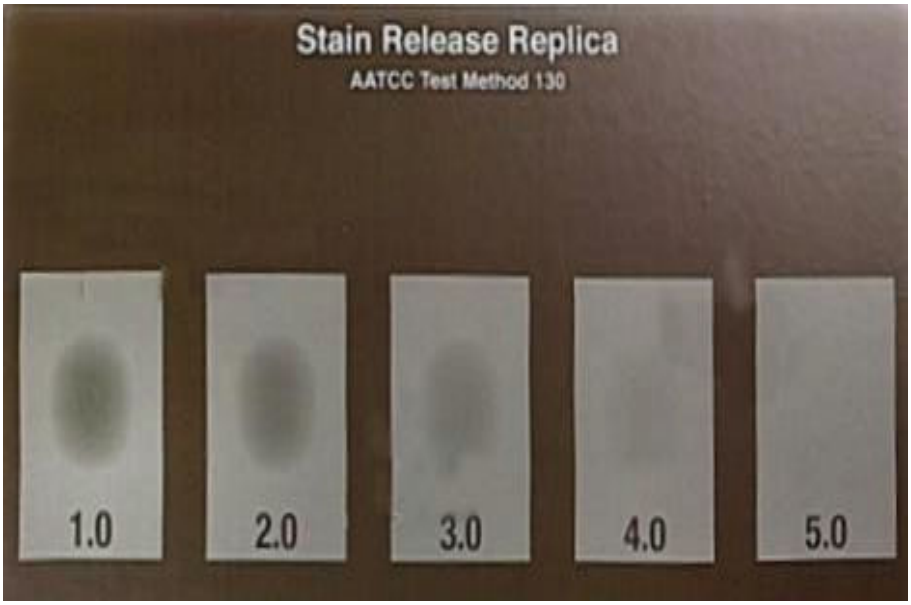

Figure 5: Stain Release Replica

RESULTS AND DISCUSSION

There are two observations that require discussion with respect to the effectiveness of stain remover on the different type of fabric with different type of stains which are lightness value from chromameter and colour change based on its visibility on the fabric after staining and washing.

Lightness Value of Cotton and Polyester Fabric

Table 3 displays the test results obtained by chromameter according to l* a* b* value for cotton fabric. Further explanation of the results is discussed in the next paragraph based on the illustration in Figure 6.

Table 3: Chromameter Test Value for Cotton

No	Stain	Fabric sample	Chromameter test value		
			L*	a*	b*
1	Coffee	CX	81.87	4.37	-1.25
		CV	83.95	4.41	-2.87
		CC	83.57	4.28	-2.40
		CL	82.38	4.34	0.88
		CV-BS	83.06	3.99	0.95
2	Engine Oil	CX	77.45	0.64	8.55
		CV	79.86	3.34	1.87
		CC	78.51	3.38	1.80
		CL	79.14	1.14	3.03
		CV-BS	75.71	3.18	4.13
3	Food Colouring	CX	72.2	-26.35	-4.81
		CV	84.34	4.07	3.88
		CC	80.34	-2.76	-8.84
		CL	83.44	2.07	-2.62
		CV-BS	83.55	3.52	-3.21

In general, the lightness value for engine oil stained cotton is lower than coffee and food colouring stain. This shows that engine oil is difficult to wash off due to its bonding with natural fibre which is strong. Commercial Brand 1 performed the best among the stain removers owing to its popularity for any types of stains. There was slight lightness difference between Commercial Brand 1, Commercial Brand 2, and vinegar and baking soda mixture with 83.95, 83.57 and 83.06, respectively. Lemon has the ability to compete with store bought stain remover as it shows better cleaning effect than Commercial Brand 2 for both engine oil and food colouring stain. The hydrophilicity of cotton fibre has made the stains to be difficult to eliminate without the presence of stain remover as the soils were absorbed into the fabric and being trapped between the fibres in short staple yarn.

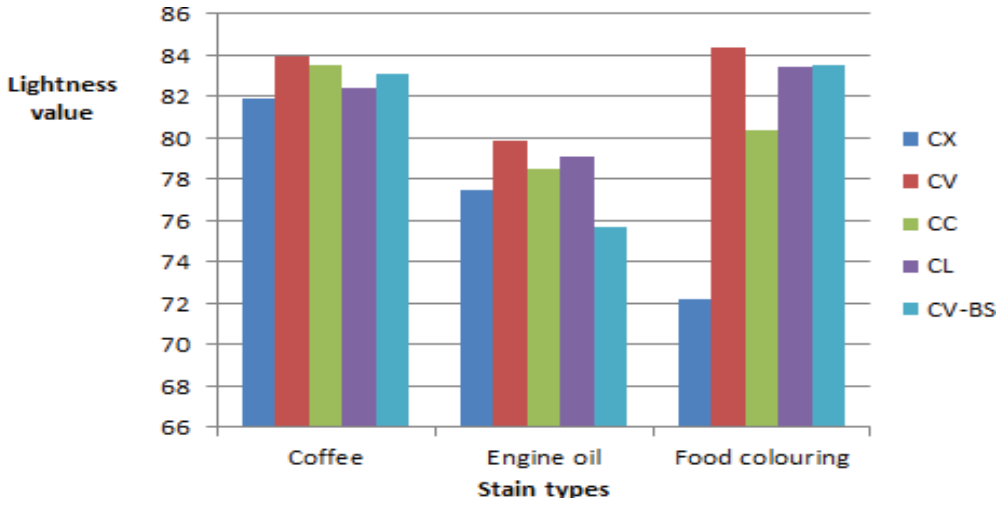

Figure 6: Lightness Value for Cotton

The lightness values for polyester fabric are presented in Table 4 and Figure 7 showing the similar trend as cotton with difficulties in eliminating engine oil stain for any kind of stain removers which is less than 80.00. Lower lightness is an indication that there were still residual stain remained in the fabric even though there was increasing of lightness after being treated with stain removers.

Table 4: Chromameter Test Value for Polyester

No	Stain	Fabric Sample	Chromameter Test Value		
			L*	a*	b*
1	Coffee	PX	81.38	3.78	-5.92
		PV	82.81	4.00	7.95
		PC	82.92	3.98	-8.03
		PL	81.22	3.66	-4.63
		PV-BS	82.59	4.12	-7.83
2	Engine Oil	PX	74.92	3.21	2.69
		PV	78.76	3.06	-1.93
		PC	79.15	3.23	-2.74
		PL	75.02	3.24	1.55
		PV-BS	79.81	3.27	3.52
3	Food Colouring	PX	80.88	3.94	-7.84
		PV	82.03	4.18	-7.81
		PC	80.88	4.03	-8.06
		PL	81.51	3.96	-7.83
		PV-BS	82.1	3.91	-7.94

Commercial Brand 1, Commercial Brand 2 and the mixture of vinegar and baking soda have shown nearly 83.00 lightness value, which is high. The performance of homemade stain remover is comparable with those commercial stain removers on polyester fabric. As compared to cotton, stains on polyester are easier to eliminate even without the use of stain remover. This is aligned with a study which confirmed that the stain removal ratio of polyester is higher than natural based fibre such as cotton and rayon [10]. Lemon shows a great performance on water-based stain such as coffee and food colouring, except on engine oil for polyester. This might due to the hydrophobicity of polyester where the stain is basically not really bound inside the fibre that makes the stains easier to remove. On the other hand, it is hard to eliminate engine oil on woven fabric as oil stain has heavier and thicker viscosity which would stuck between fibres in the interlacement of yarns. A greasy stain like oil could be only removed effectively by using surfactant which helps oil to dissolve in water [1].

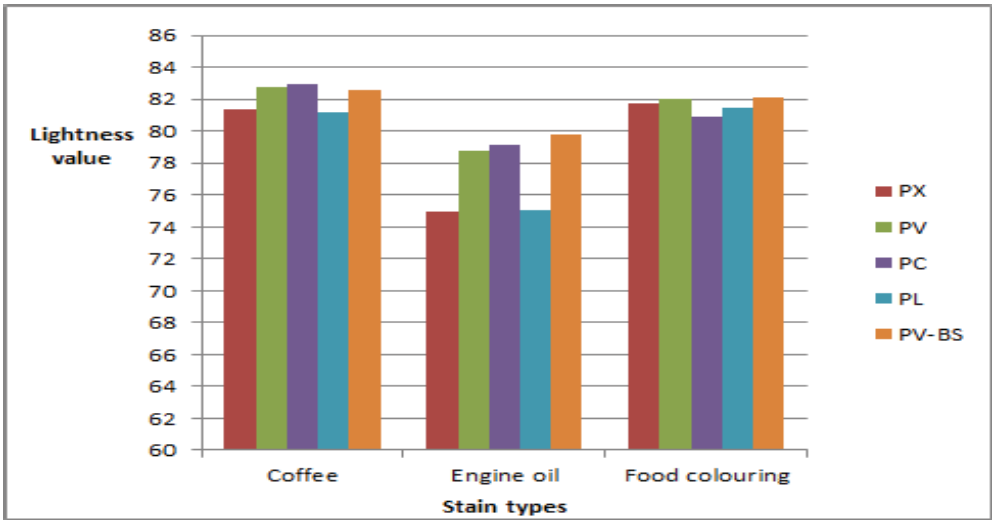

Figure 7: Lightness Value for Polyester

Stain Release Rating of Cotton and Polyester Fabric

Stain release results are shown in Table 5, where the best rating of coffee stain was obtained by Commercial Brand 1, Commercial Brand 2 and vinegar with baking soda which achieved 5 rating each. On the other hand, rating 1 was obtained by lemon which is similar to fabric without stain remover application.

Table 5: Stain Release Rating for Cotton and Polyester

No	Fabric Sample	Type of stain		
		Coffee	Engine oil	Food colouring
1	CX	1	2	1
2	CV	5	4	5
3	CC	5	3	2
4	CL	1	4	5
5	CV-BS	3	3	5
6	PX	4	3	5
7	PV	5	4	5
8	PC	5	5	3
9	PL	3	3	5
10	PV-BS	5	4	5

Generally, food colouring can be removed eRectively by commercial and home prepared ingredients with rating 5, except Commercial Brand 2, which presents rating 3. Coffee and food colouring stains were easier to remove from polyester in comparison with cotton except for Commercial Brand 1 stain remover, as it works best on both types of fabrics. This finding was supported by a research which reported that coffee stain has little affinity to polyester fibres but adheres more to cotton [11]. All of the stain removers could effectively clean the food colouring stain out of the tested samples except for Commercial Brand 2. This could be caused by the characteristics of the soil itself as it is water based. Hence it is easy to remove because of the low viscosity, while the oil stains are less likely to wash away because it is high in viscosity.

Overall Score

The results obtained from the previous discussion are simplified in a score sheet as in Table 6 by selecting the best three stain removers for each of fabric and evaluation. The overall score shows that Commercial Brand 1 with higher price gave the best cleaning performance on both polyester and cotton. Formulation of vinegar and baking soda on polyester shows comparable performance with a more expensive commercial stain remover, while a cheaper stain remover which is Commercial Brand 2 had moderate performance. It can also be said that lemon alone is not a good option to remove stain on man-made fibre.

Table 6: Overall Score for Stain Removers

Fabric	Evaluation	Stain Types	No Stain Remover	Commercial Brand 1	Commercial Brand 2	Lemon Juice	Vinegar + Baking Soda
Cotton	Lightness	Coffee		√	√		√
		Engine Oil		√	√	√	
		Food Colouring		√		√	√
	Stain Release	Coffee		√	√		√
		Engine Oil		√	√	√	√
		Food Colouring		√		√	√
	SCORE			6	4	4	5
Polyester	Lightness	Coffee		√	√		√
		Engine Oil		√	√		√
		Food Colouring	√	√			√
	Stain Release	Coffee		√	√		√
		Engine Oil		√	√		√
		Food Colouring		√		√	√
	SCORE		1	6	4	1	6
TOTAL SCORE			1	12	8	5	11

CONCLUSION

As conclusion, results from this work would assist consumers with their home laundering and provide a better understanding on how to prepare stain remover by using home ingredients at minimal cost. The combination of vinegar and baking soda showed a great cleaning effect on polyester for coffee, engine oil and food colouring stain, whilst lemon could only remove engine oil and food colouring on cotton. The commercial textile stain removers on the other hand eliminated the stains well on both polyester and cotton. Textile stain remover can be prepared at home with limited performance as compared to commercial stain remover. Nevertheless, it still can be an initiative to reduce the consumption of store bought cleaning products for a healthier lifestyle and less bad impact to the environment.

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