EFFECTIVE WASHING STUDY OF EYELINER STAINED FABRIC WITH EMULSIFIERS DERIVED *PEARL MILLET* AMYLASE BOUND BSA NANOPARTICLES WITH DETERGENTS AS BIO-ACTIVE LAUNDRY ADDITIVES

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ABSTRACT

Amylases are industrially important enzymes that catalyse starch breakdown into smaller glucose and maltose units. This catalyzing property has been immensely in textile and detergent industries used for desizing and stain removal. Amylase is stabilized via immobilization onto a non-toxic semi-permeable support and amylase was bound in bovine serum albumin (BSA) fabricated nanoparticles was prepared for its further use in detergent industry. In this work, we extracted amylase form *Pearl millet* and bound in BSA nanoparticles with four different emulsifiers e.g. Almond Oil, Jasmine Oil, Mustard Oil, and Olive Oil. Olive Oil driven nanoparticles was showed the most efficient amylase entrapment closely followed by Almond oil, Mustard Oil ad Jasmine oil. These fabricated nanoparticles were then used as bio-active detergent additives when used with different detergents named, Ariel matic, Surf excel liquid, Active wheel and Tide plus. These detergents possess most advanced technology for stain removal and are one step better than their predecessors, used in studies previously. These were tested for their stain removal competency. The stains chosen in this study were comprised of cosmetic stains, of black eye-liners of 5 different international brands namely, Revlon, Lakme, Chamber and Givenchy. These routine stains are tough to remove and often require pre-treatment before actual washing to obtain stain free cloth or expensive dresses. Hence, an excellent experimental observation was elucidated from this study and all strains are better removed if when washed with chosen detergents with the prepared enzyme bound nanoparticles mixture as compared to when washing was done only with chosen strains only. Among them, Ariel matic detergent with enzyme loaded bovine serum albumin nanoparticles was found to be the best washing bio-active system as compared to other chosen detergent samples, followed by Surf excel liquid, Tide plus and the least effective was found to be Active wheel. Upon comparing the prepared enzyme bound BSA nanoparticles, Almond and Olive oil driven nanoparticles was showed excellent washing capabilities when coupled with Ariel matic while mustard oil nanoparticles with Ariel matic also showed very good results. Furthermore, very good results were also observed when washing with Almond and Olive Oil driven nanoparticles with Surf Excel liquid while fairly good results were shown by Jasmine oil driven and Mustard Oil driven nanoparticles followed by Almond and Olive Mustard Oil driven nanoparticles with Active wheel and tide plus. And, less washing efficiency was observed when washing was done with Jasmine oil driven nanoparticles

KEYWORDS: Eye liner; Almond oil; Olive oil; Jasmine Oil; mustard oil; BSA nanoparticles; Detergents

INTRODUCTION

Industrially important class of enzymes, Amylases (4-a-D-glucan glucano hydrolase (EC 3.2.1.1.) are known to catalyze the hydrolysis of internal glycosidic linkages in starch into low molecular weight products such as glucose, maltose , maltotriose units ,limit dextrins have been extensively utilized in food, fermentation, textile paper, detergent, pharmaceutical and fine-chemical industries [1,2,3]. The immense potential of the enzyme has been exploited in a multitude of processes such as bread making, production of glucose and fructose syrup, liquefaction, sacchrification, brewing, distillation, fuel ethanol production, desizing of textile [4,5,6,7]. 75% of the textile industry use starch for strengthening the threads of a fabric before weaving. Removing the starch after weaving is an important step since it might hinder the uniformity of the wetting process. An effective method of desizing is using amylase to breakdown starch into smaller oligosaccharide units which are water soluble [8.9]. Amylase is quite fabric friendly because it does not damage threads of the fabric while desizing unlike other chemicals such as persulphate and alkali or bromide [10,11]. Most recently the demand for amylase in laundry and detergent industry has also been rapidly increased and establishing itself as an important ingredient as detergent additive with liquid household detergents being used as stain removers, laundry prespotters, automatic dishwashing detergents, and industrial and institutional cleaning stencils[12]. According to reports, 30% of the enzymes produced industrially, successfully used in the detergent industry and have tested to improve cleaning efficiency. In 1913, enzymes have been effectively and routinely incorporated into detergents mainly bdue to having good thermal stability, required less amount of water during processing and reduce labor cost and easy handling when bound onto eco-friendly biodegradable, non-toxic and non-corrosive supports [13,14]. Amylases degrade the residues of starchy foods to dextrins and other smaller oligosaccharides (glucose, maltose etc) which are water soluble and are thus easily washed off [15,16]. Immobilization of enzyme is found to be best and cost effective method to increase the shelf life and thermal stability of an enzyme [17, 18]. This provides the advantage of increases stability, easy recovery, easy separation of reactant and product, repeated or continuous use of a single batch of enzyme saving labor and overhead costs, with addition to improving storage, pH operational, thermal, conformational stabilities, and rapid termination of the reactions [19, 20, 21]. In present work, we used the *Pearl millet* amylase bound BSA nanoparticles to wash the stained cloth pieces with 40U of alkaline protease solution and chosen detergents samples and compared their washing results with detergent washing only. Chosen stains were tested for the washing efficiency with amylase loaded nanoparticles. Chosen strains were grouped into cosmetic stains of eye-liner of well known international brands; Revlon, Lakme, Chamber geneva, Givenchy. Selected detergents used for stain removal were *Active Wheel*, by Hindustan Unilever Ltd. (HUL) containing less than 10% active ingredient sodium alkyl benzenesulphonate. *Ariel Matic*, by Procter and Gamble containing

approximately 16% active ingredient and 63, 95 detergency. *Surf Excel Liquid* by Hindustan Unilever ltd and *Tide Plus* manufactured by Procter and Gamble having 9.90% detergency and alkalinity at 22%. [22]

2. MATERIALS AND METHODS

The Almond, Jasmine, Mustard and Olive oil driven chemically modified *Pearl millet* amylase bovine serum albumin were used for this study prepared by Rani K, *et al* [13,23,24]. These bioactive detergent additives was used in vanishing of dry tough cosmetic stained cloth pieces in combination of various detergents such as Active wheel, Ariel matic, Surf excel liquid and Tide plus. Selected stained cloth pieces having cosmetic stains of eyeliners from Revlon, Lakme, Chamber geneva, Givenchy. These were soaked in reaction mixture solution of 2 mg of prepared enzyme loaded bovine serum albumin nanoparticles with 1ml of slected detergent solution in petri plates. Each sample of stained cloth piece was tested with their washing with chosen four different detergents only and with the combination of above mentioned reaction mixture of Almond, Jasmine, Mustard and Olive oil driven emulsified enzyme bound bovine serum albumin nanoparticles for carrying out its comparative washing results to get washing efficacy of our prepared nanoparticles as bio-active detergent additives.

Figure 1: Chosen Eyeliners stains for staining the fabric pieces to be tested for washing efficacy.

RESULTS AND DISCUSSION

Almond, jasmine, mustard and olive oil driven emulsified bovine serum albumin nanoparticles of encapsulated Pearl millet (*Pennisetum glaucum)* amylase were studied with four different samples of detergent solutions of Active wheel, Ariel matic, Surf excel liquid and Tide plus to remove cosmetic stains of selected eyeliners from stained clothes. Generally, these kinds of tough strains are usually not removed completely in one wash. Therefore, amylase loaded bovine serum albumin nanoparticles with various detergents were used for washing to remove the chosen dry tough strains from stained cloths which enhanced the effectiveness of detergents for washing of dry and hard stains from clothes. When, we washed the stains with the chosen detergent samples and enzyme loaded nanoparticles with effective units of 40 U of alkaline protease solution to lease out

the amylase from the BSA nanoparticles for their sustained and controlled release. Previously, the application of nanoparticles of encapsulated amylase was studied by using coconut oil as emulsifier to prepare the enzyme bound BSA nanoparticles and washing was done with chosen samples of detergent solutions of Ariel, Surf excel, Wheel and Tide to remove rust, gel ink pen, grease, chocolate , coffee, tea, pomegranate and turmeric stains form clothes [14][16]. Presently, more extensive study have been carried out on advanced detergents solutions like Ariel matic, Surf excel liquid, Active wheel and Tide plus are used along with amylase encapsulated nanoparticles using four different emulsifier Almond, jasmine, mustard and olive oil to remove various cosmetic stains along with 40U of alkaline protease solution for their sustained and controlled biodegradation. Because alkaline protease is also reported efficient enzyme which can resist in harsh condition and quite friendly in alkaline environment of washing [25]. Among the four samples of detergent solution Ariel matic detergent with enzyme loaded bovine serum albumin nanoparticles was found to be the best washing bio-active system as compared to other chosen detergent samples (Table 1). In previous reports also, Ariel matic with entrapped enzyme has shown better washing results as compared to other detergents which are similar to our washing results [13,14, 15, 16]. It was followed by Ariel matic detergent, Surf excel liquid with enzyme loaded bovine serum albumin showing pretty good results [22,23,24,26] (Fig 2). Therefore, on comparing the four different samples of prepared Almond, Jasmine, Mustard and Olive driven emulsified bovine serum albumin nanoparticles, Almond and Olive oil driven emulsified nanoparticles along with Ariel matic detergent had gave excellent results as compared to Jasmine and Mustard driven emulsified nanoparticles. Also, Almond and Olive oil driven emulsified nanoparticles gave very good results with Surf excel liquid followed by fairly good washing results with Active wheel and Tide plus compared to Mustard oil driven emulsified nanoparticles. Jasmine oil driven emulsified nanoparticles was least efficient as bio active system with Tide plus and Active wheel detergent [22,23,24,26] (Fig 3, 4 & 5).

Table 1: Washing results of stained clothes with chosen detergents and different samples of prepared emulsifiers driven bovine serum albumin nanoparticles by Rani K, et al [13, 23, 24]

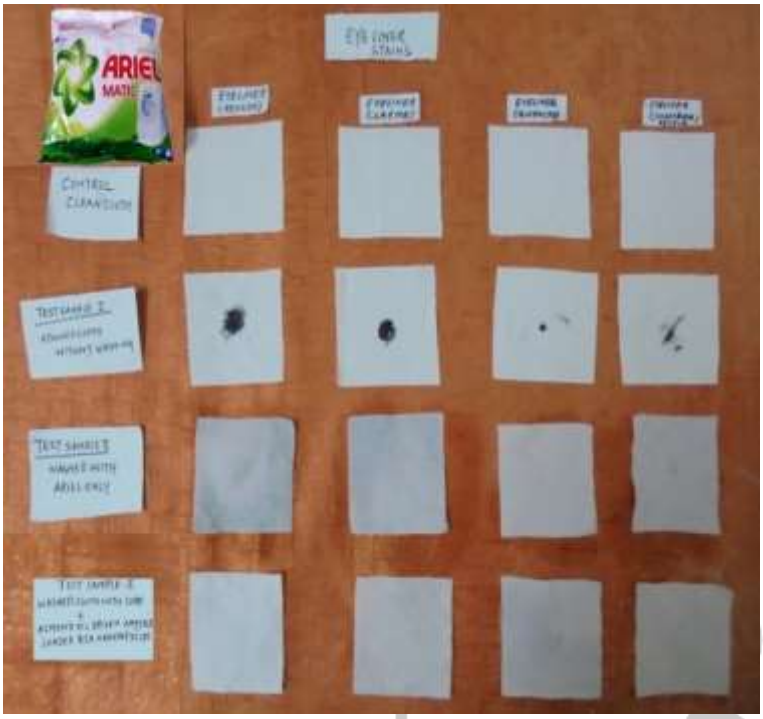
Emulsifier / Detergent	Almond	Jasmine	Mustard	Olive
Ariel matic	Excellent	Very good	Very good	Excellent
Surf excel liquid	Excellent	Good	Fairly good	Excellent
Tide plus	Very good	Good	Fairly good	Very good
Active Wheel	Fairly good	Good	Good	Fairly good

CONCLUSION

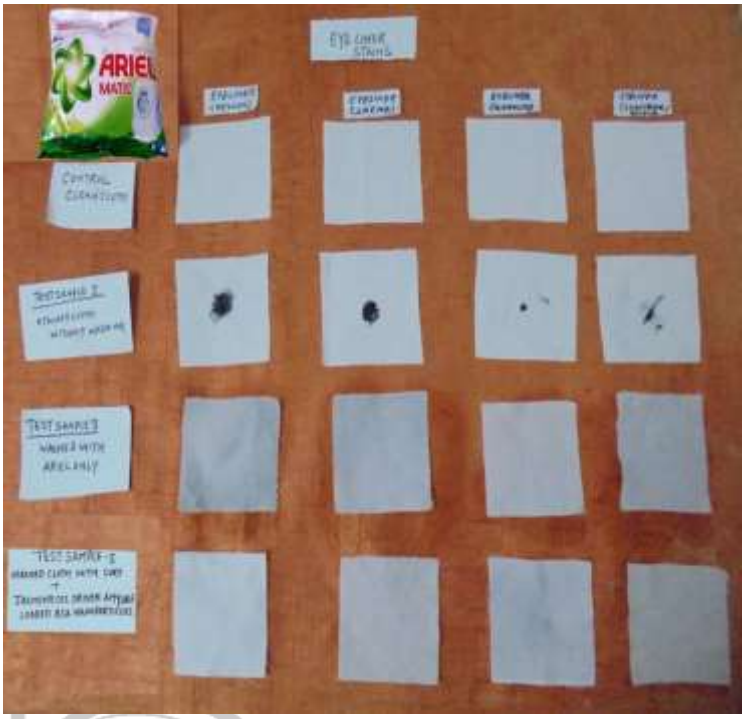
Hence, form this experimental study, it was concluded that the use of enzyme bound bovine serum albumin nanoparticles with alkaline protease solution with detergents was found to be very cost-effective with improved washing efficacy when used as eco-friendly bio-active detergent additives. And, the present study can might have been contribute to decrease the washing labor and water consumption along with proved quite helpful to maintain mild condition for fabric without causing any skin irritation during the washing.

Figure 2 : Washing results of eye-liner stained cloth with **Ariel matic alone** and **Ariel matic** with **amylase loaded nanoparticles prepared with different emulsifiers-** Almond Oil, Jasmine Oil, Mustard Oil and Olive Oil

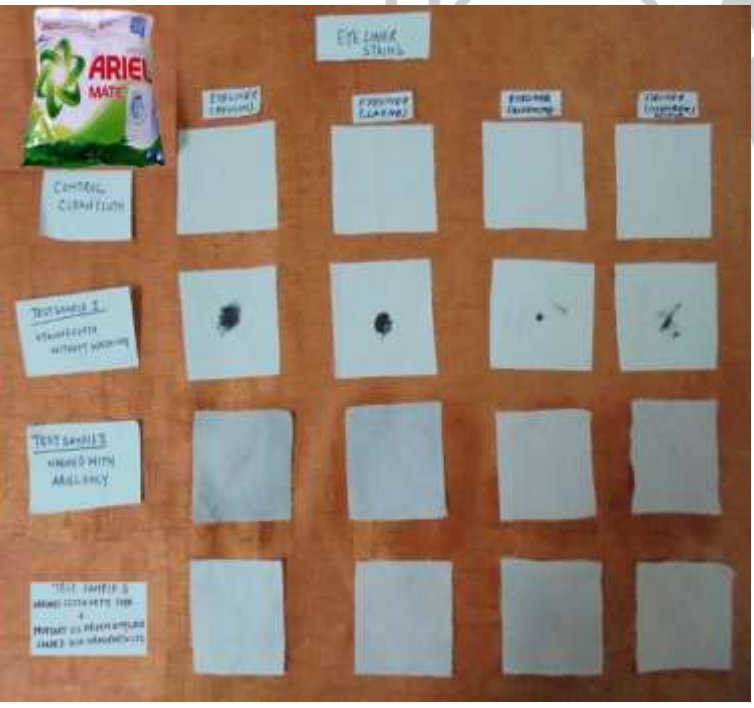
(A)Washing results with Almond Oil driven nanoparticles



(B) Washing results with Jasmine Oil driven Nanoparticles



(C) Washing results with Mustard Oil driven driven nanoparticles



(D) Washing results with Olive Oil driven nanoparticles

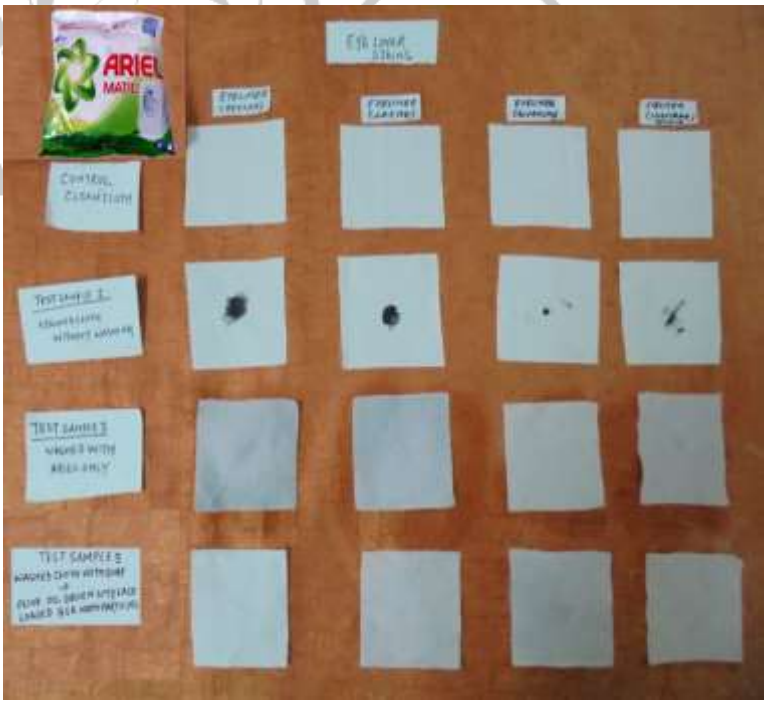
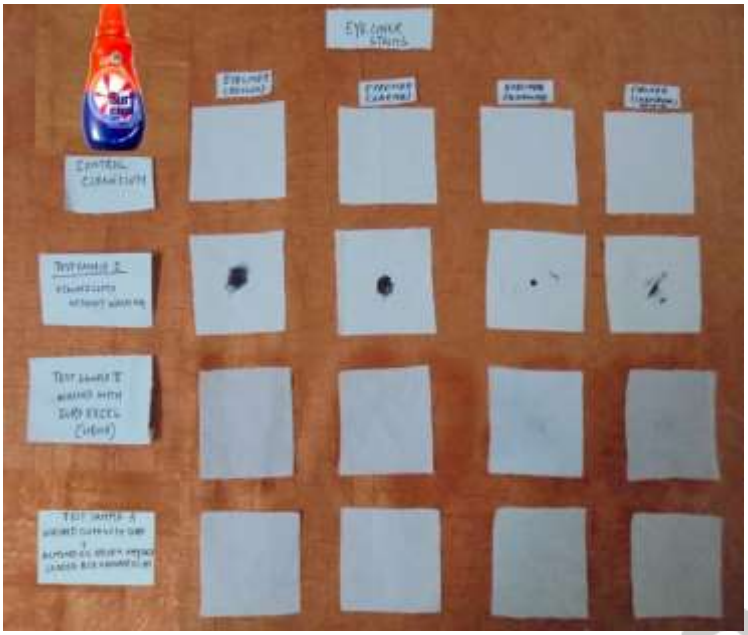
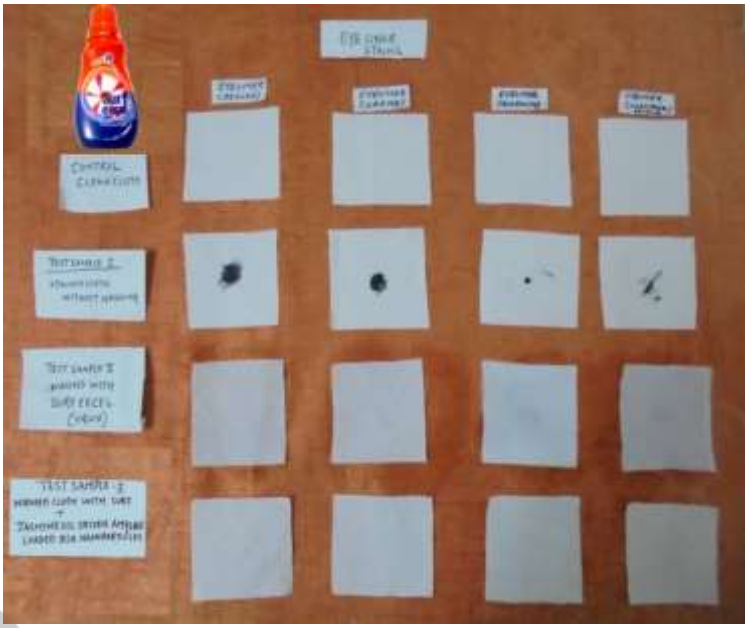


Figure 3: Washing results of eye-liner stained cloth with **Surf Excel alone** and **Surf Excel** with **amylase loaded nanoparticles prepared with different emulsifiers-** Almond Oil, Jasmine Oil, Mustard Oil and Olive Oil

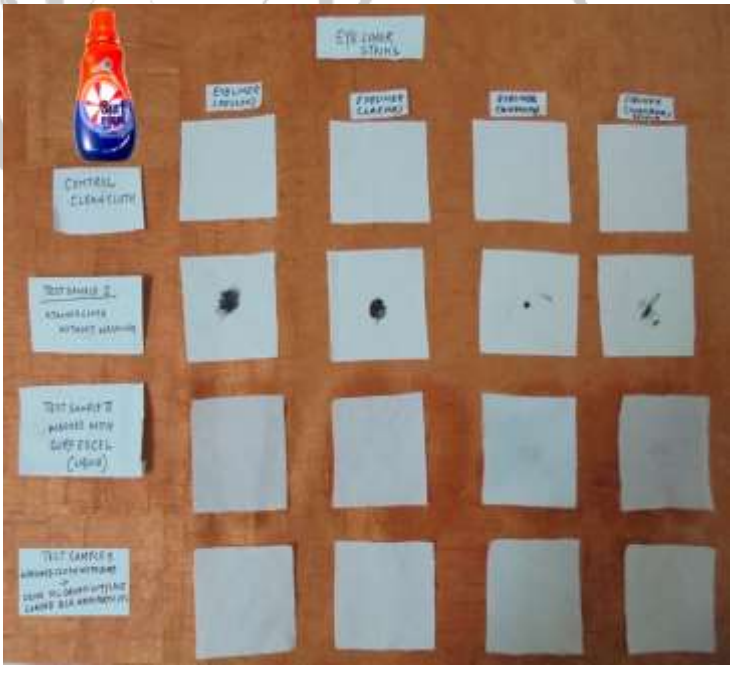


(A)Washing results with Almond Oil driven driven nanoparticles



(B) Washing results with Jasmine Oil driven Nanoparticles

(C) Washing results with Mustard Oil driven driven nanoparticles



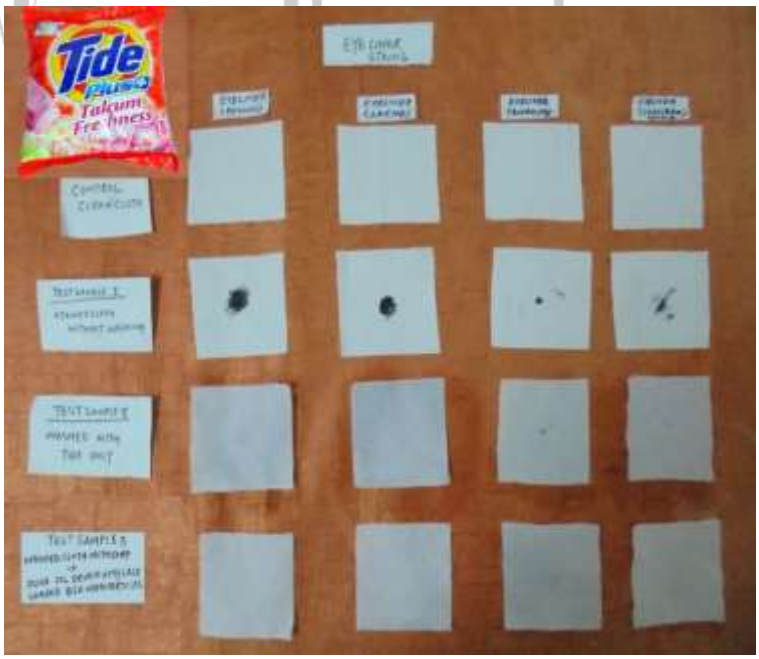
(D) Washing results with Olive Oil driven nanoparticles

Figure 4 : Washing results of Eye-liner stained cloth with **Tide Plus alone** and **Tide Plus** with **amylase loaded nanoparticles prepared with different emulsifiers**- Almond oil, Jasmine Oil, Mustard Oil and Olive Oil

(A)Washing results with Almond Oil driven driven nanoparticles

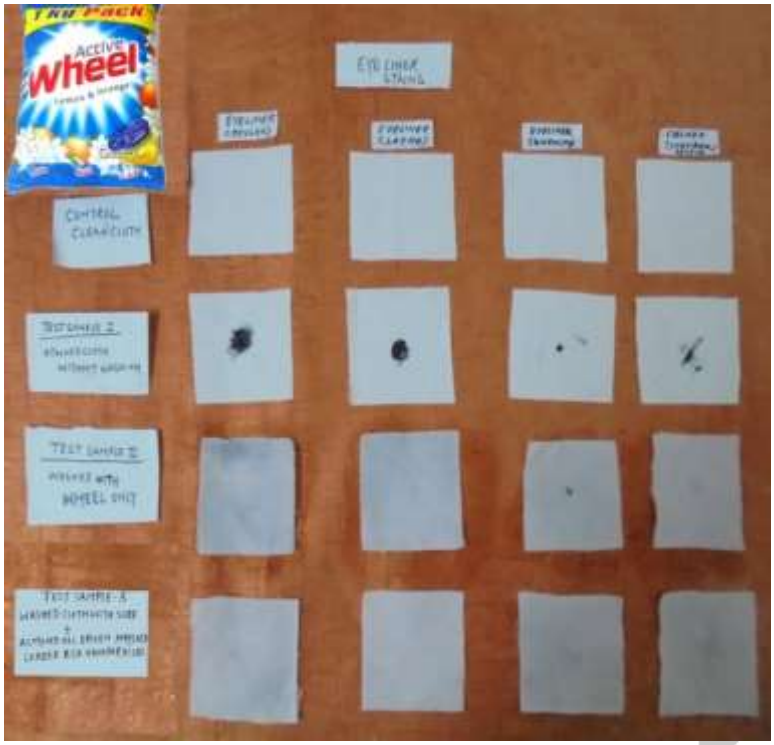
(B) Washing results with Jasmine Oil driven Nanoparticles

(C) Washing results with Mustard Oil driven driven nanoparticles

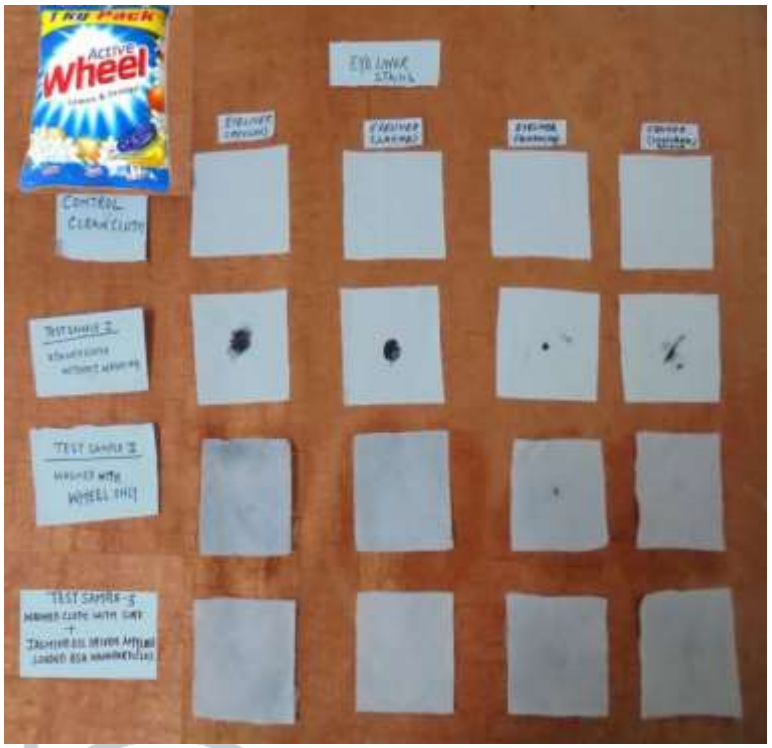


(D) Washing results with Olive Oil driven nanoparticles

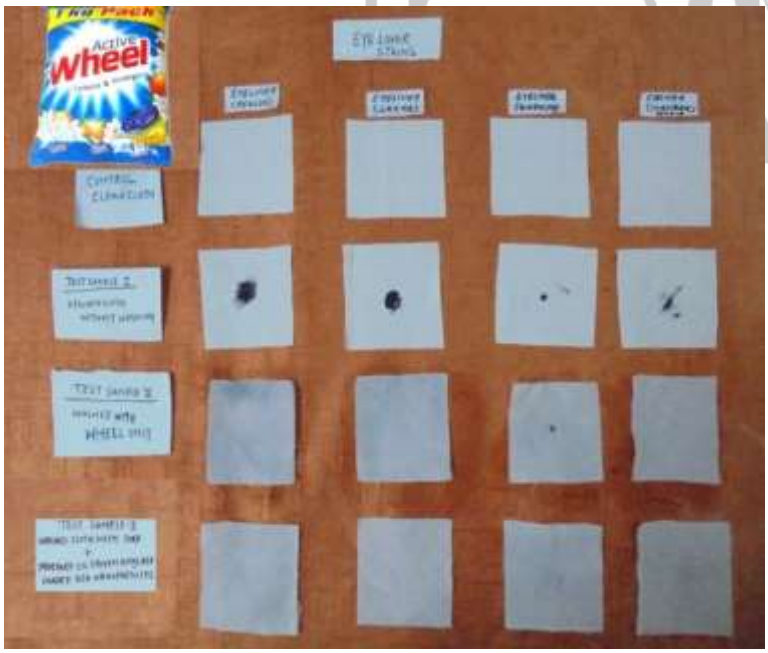
Figure 5: Washing results of Eye-liner stained cloth with **Active Wheel Alone** and **Active Wheel** with **amylase loaded nanoparticles prepared with different emulsifiers**- Almond oil, Jasmine Oil, Mustard Oil and Olive Oil



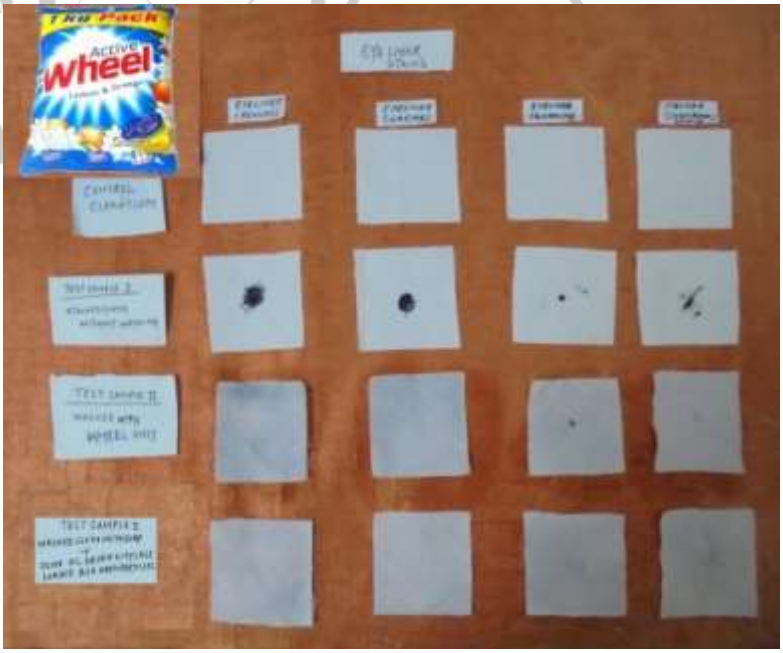
(A)Washing results with Almond Oil driven driven nanoparticles



(B) Washing results with Jasmine Oil driven Nanoparticles



(C) Washing results with Mustard Oil driven driven nanoparticles



(D) Washing results with Olive Oil driven nanoparticles

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