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TO STUDY WASHING EFFICACY OF MEHNDI, AALTA, DRY SINDOOR, WET SINDOOR STAINED FABRIC WITH DIFFERENT EMULSIFIERS MEDIATED *PEARL MILLET* AMYLASE BOUND BSA NANOPARTICLES AS DETERGENT-ADDITIVES

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ABSTRACT
Catalyzing property of amylase has been exploited in textile and detergent industries for desizing and stain removal. Amylase is stabilized via immobilization onto bovine serum albumin (BSA) to prepare their fabricated nanoparticles. In this work, we extracted amylase form *Pearl millet* and bound in BSA nanoparticles with four Almond Oil, Jasmine Oil, Mustard Oil, and Olive Oil as naturally occurring emulsifier which don't have any toxic effect. These fabricated nanoparticles were used as bio-active detergent additives with different detergents named, Ariel matic, Surf excel liquid, Active wheel and Tide plus. These were tested for their stain removal competency to get washing efficacy. The stains slected in this study were comprised of cosmetic stains, namely, Mehndi, Aalta, Dry sindoor, Wet sindoor. These traditional or festive cosmetics stains are tough to wash off and often require pre-washing practice. Hence, effective comparative study was carried out from this study and all strains are very well vanished if when washed with chosen detergents with the prepared enzyme bound nanoparticles mixture as compared to when washing was done 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. Among the prepared enzyme bound BSA nanoparticles, Almond and Olive oil driven nanoparticles was showed excellent washing efficacy when coupled with Ariel matic while mustard oil nanoparticles with Ariel matic also showed very good washing results. Furthermore, very good results were also observed when stained cloth washed 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, least washing efficiency was found to be for Jasmine oil driven BSA nanoparticles.

KEYWORDS: Mehndi, Aalta, Dry sindoor, Wet sindoor; Almond oil; Olive oil; Jasmine Oil; mustard oil; BSA nanoparticles; Detergents.

INTRODUCTION
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 glucose, maltose, maltotriose units, limit dextrins. Amyalses have been extensively utilized in food, fermentation, textile paper, detergent, pharmaceutical and fine-chemical industries.[1,2,3] The potential of the enzyme has been exploited in 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 was reported the use of amylase in processing of starch for strengthening the threads of a fabric before weaving and further their use in desizing of fabrics.[8.9] Amylase is fabric friendly because it does not damage 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 increased as detergent additive with liquid household.[12] According to reports, 30% of the enzymes is produced industrially and successfully used in the detergent due 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 matices.[13,14, 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, 19] Advantage of enzyme was 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 after the immobilization. It is also lead to improve storage, pH operational, thermal, conformational stabilities, and rapid termination of the reactions.[20, 21, 22] In present work, we have 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 powder only. Chosen stains were subjected to test for the washing efficiency with amylase loaded nanoparticles. Chosen strains were grouped into traditional or festive cosmetic stains of Mehndi, Aalta, Dry sindoor, Wet sindoor. Selected detergents used for stain removal were *Active Wheel*, by Hindustan Unilever Ltd. (HUL); *Ariel Matic*, by Procter and Gamble; *Surf Excel Liquid* by Hindustan Unilever ltd and *Tide Plus* manufactured by Procter and Gamble.

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,* 2015.[15, 25, 26, 29] These bio-active laudary additives with proteolytic enzyme was used in leaching 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 strains were of traditional and festive cosmetic strains of Mehndi, Aalta, Dry sindoor, Wet sindoor to strain the cloth pieces. These strained cloth pieces were soaked in reaction mixture of 2 mg of prepared enzyme loaded bovine serum albumin nanoparticles with 1ml of selected 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 amylase loaded BSA nanoparticles to carry out its comparative washing study to get washing efficacy of our prepared nanoparticles as bio-active detergent additives.

RESULTS AND DISCUSSION

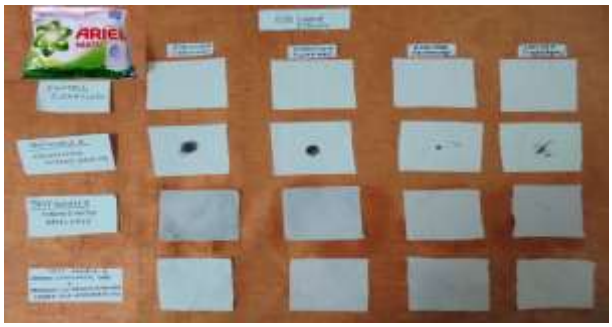
Figure 1: Chosen Mehndi, Aalta, Dry sindoor, Wet sindoor stains for staining the fabric pieces to be tested for washing study.

Almond, jasmine, mustard and olive oil driven emulsified bovine serum albumin nanoparticles of encapsulated Pearl millet (*Pennisetum glaucum)* amylase were subjected to study with four detergent solutions of Active wheel, Ariel matic, Surf excel liquid and Tide plus to remove stained cloth pieces of Mehndi, Aalta, Dry sindoor, Wet sindoors. Generally, these kinds of tough strains are usually not removed in one wash and require quite tedious pre-treatment practices e.g. long hour of soaking in warm water, rigorous wash-brushing and use of any stain dissolving agents like potash alum or vinegar etc. Therefore, amylase loaded bovine serum albumin nanoparticles with selected detergents were used for washing to remove the chosen dry tough strains from stained cloths. That was lead to enhance the effectiveness of detergents for washing. When, we were washed the stains with the chosen detergent samples and prepared nanoparticles with effective units of 40 U of alkaline protease solution (proteolytic enzyme) to release of bound amylase from nanoparticles for their sustained and consistent release. Previously, the application of nanoparticles of encapsulated amylase was reported for washing study and those were prepared by using coconut oil as emulsifier. 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 for clothes.[8,11,16,18] Presently, more extensive study have been carried out on advanced detergents solutions like Ariel matic, Surf excel liquid, Active wheel and Tide plus were 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 was also reported efficient enzyme which can resist in harsh condition of washing due to its alkaline nature.[27] Among the four samples of detergent solution Ariel matic detergent with amylase bund BSA nanoparticles was found to be the effective washing bio-active system as compared to other chosen detergent samples (Table 1). Previously, Ariel matic with entrapped enzyme has shown better washing results as compared to other detergents which are similar to our washing results.[125,25, 27, 28] It was followed by Ariel matic detergent, Surf excel liquid with enzyme loaded bovine serum albumin having good results[22, 23, 24, 27, 28] (Fig 2). Therefore, on comparing the four different samples of prepared different emulsifiers derived bovine serum albumin

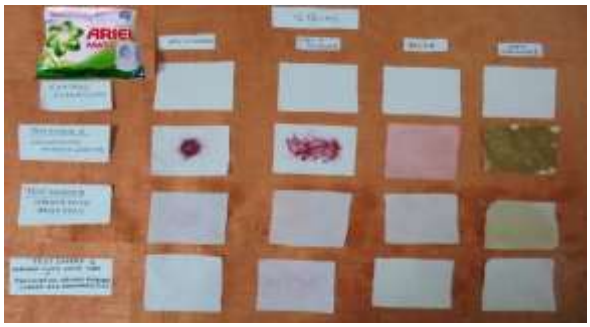
nanoparticles, Almond and Olive oil driven emulsified nanoparticles along with Ariel matic detergent and Surf excel liquid had gave excellent results as compared to Jasmine and Mustard driven emulsified nanoparticles. Also, Almond and Olive oil driven emulsified nanoparticles were shown good results with Surf excel liquid followed by fairly good washing robservations with Active wheel and Tide plus. As compared to Mustard oil driven emulsified nanoparticles, Jasmine oil driven emulsified nanoparticles was found to be least efficient 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 (Mehndi, Aalta, Dry sindoor, Wet sindoors) with chosen detergents and different samples of prepared emulsifiers driven bovine serum albumin nanoparticles by Rani K, *et al, 2015*[15, 25, 26, 29]

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



(A)Washing results with Almond Oil driven driven nanoparticles

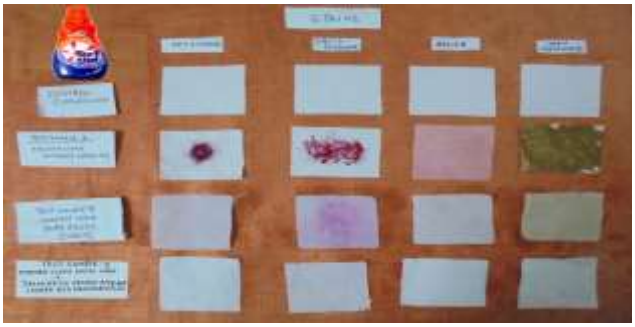


(B) Washing results with Jasmine Oil driven nanoparticles

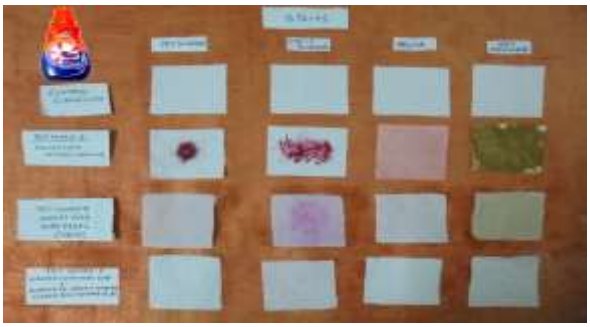
(C) Washing results with Mustard Oil driven driven nanoparticles

(D) Washing results with Olive Oil driven nanoparticles

Figure 2 : Washing results of Mehndi, Aalta, Dry sindoor, Wet sindoor 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 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 Mehndi, Aalta, Dry sindoor, Wet sindoor 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 Mehndi, Aalta, Dry sindoor, Wet sindoor 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 Mehndi, Aalta, Dry sindoor, Wet sindoor 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

CONCLUSION

Hence, form the present study, it was coined that use of *Pearl millet* extracted amylase loaded BSA with alkaline protease solution and different selected detergents was very cost-effective and time saving practice with improved washing efficacy as compared to normal washing practice. The prepared enzyme loaded BSA nanoparticles were excellent eco-friendly bio-active detergent additives that 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. This washing study can might be proved further a new landmark for textiles and detergent industries for washing and desizing of fabrics to cut down the cost of industrial processing lineages keeping the point of conserving time and energy.

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