ENZYME-ACTIVE LAUNDRY PRODUCTS: REPORTED USE AND EFFECTIVENESS BY SELECTED GROUP OF WOMEN

by 1264

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INTRODUCTION

One of the most recent developments in home laundry products has been the use of enzyme additives. Although enzymes have been used by man for centuries for many everyday processes, using enzymes as a laundry aid is a relatively recent innovation. Dry cleaners have successfully used enzyme preparations for spot removal for a number of years and approximately fifty years ago enzymes were tried unsuccessfully in laundry products. Reintroduction of enzymes as home laundry aids occurred three years ago in the United States and five years ago in Europe.

This report will include a review of literature on the development of the enzymes as cleaning agents, how the enzymes work as cleaning agents, physical conditions found to affect performance of enzymes, and experimental results of enzymes in stain removal.

Results of a questionnaire administered to a group of Kansas Extension Homemaker Unit members to determine their acceptance and use of the enzyme-active laundry products also is included in this report. Objectives of the questionnaire were to obtain information on the following aspects:

1. the homemaker's awareness of enzyme laundry products.
2. how the homemaker first gained information about the enzyme laundry products.
3. what influenced the homemaker to purchase an enzyme laundry product.
4. the homemakers use and reported effectiveness of enzyme pre-soak products.

5. the homemakers use and reported effectiveness of enzyme detergents.

6. which of specified stains are considered by the homemaker as most difficult to remove and how enzyme products are used in stain removal.

7. the homemaker's selection of stain-removal methods.

REVIEW OF LITERATURE

Development of Enzyme Laundry Products

The use of enzymes in laundry products is not new. Approximately fifty years ago, pancreatic enzymes were investigated and soaking products containing enzyme systems were marketed. The soaking products were not accepted widely at that time because the small percentage of the enzyme used and its unstability at water temperatures and alkalinity normally used in home laundry situations proved them to be ineffective (9). Dry cleaners have used enzyme-based products for removal of specific kinds of spots for many years (2, 4, 20). Within the last twelve years, renewed interest has been shown in enzymes as laundry aids. When the soap makers for the meat and fish handling industries in Europe were looking for a detergent formulation capable of removing heavy protein stains, enzymologists at a Denmark firm produced an acceptable enzyme which could be used in a detergent formulation for stain removal. This was the beginning of the enzyme craze both in Europe and the United States (9).

Man has used enzymes unwittingly for centuries in many everyday activities, such as the leavening of bread, ripening of cheese, and fermentation of wine and beer, but it has been only during the last few years that much has been learned of the intricate structure and functions of enzymes. During the last half century industrial use of enzymes has encompassed a wide range of activities including the textile and leather

industries, manufacture of paper and adhesives, sewage disposal, animal feeding, chemical and pharmaceutical applications and garment cleaning (15). Other current and future uses of enzymes include: use in the medical field as possible cancer cures, for the treatment of heart disease, metabolic disorders, and to help in eliminating digestive disorders; use by the food and brewery industry to improve flavor and nutritional value of foodstuffs; and as a cleaning agent for dishes (11, 20).

Enzymes are proteins and are found in all living matter. The basic ingredients of an enzyme, as of other proteins, are amino acids. Carbon, hydrogen, nitrogen and sometimes sulfur, make up the approximately twenty amino acids found in enzymes (15).

Functions and types of enzymes

There are two major functions of enzymes. One is to accelerate the rate of chemical reactions without changing themselves. The other to work selectively on specific chemical reactions. Each specific enzyme is capable of acting as a catalyst to certain reactions. The specific reaction that the enzyme will catalyze is determined by the particular amino acid combination and its particular geometry or shape (15, 18). Enzymes promote hydrolysis of substances into smaller more easily removed particles. Enzymes which promote this type of activity are classified as hydrolases. Enzymes used in laundry

products react to stains in the same manner as do human digestive enzymes in breaking food down into a more assimilable form (4).

Although there are many enzymes in the hydrolase classification the laundry industry is mainly concerned with the following three types: proteases which act on protein substances, amylase which promote starch breakdown, and lipases which hydrolize fats (4, 6, 20). The enzyme-active laundry products available now contain either a protease enzyme, an amylase enzyme, or a combination of the two (20). Depending on the type of enzyme used, the enzyme-active laundry products are able to remove body soil, grass, blood, egg, milk, baby formula, baby food, gravy, chocolate, some vegetable, fruit or other food stains (17).

Lipase enzymes, which work on greases and fats, were reported to have detrimental effects on septic tank systems in August, 1968, (20). McCabe in August, 1969, (17) reported all three types of enzymes were being used in products marketed now, and were fully biodegradable, caused no problem in sewage treatment plants, and have no adverse effects on septic tank operations.

The function of the enzymes commonly used varies. The primary purpose of including the proteolytic enzymes in laundry products is to convert the insoluble protein material in the stains to more easily removed simple amino acids (6). When the protein substances are broken down into smaller size

particles, their function as binding agents of dirt to the fabric fibers is destroyed. Detergency then completes the removal of the unwanted particles (13). The other two types of enzymes which could be used, the amylase and lipase enzymes, work in a similar manner on starches and fats and greases.

Physical factors affecting effectiveness

Since the introduction of enzyme products in the United States in 1966, many brands of both laundry detergents with enzyme additives and enzyme-active laundry pre-soak products have reached the market (16). The enzymes used in these products are the result of technology which produced enzymes more resistant to alkalinity and heat found in home laundry situations than the enzyme products marketed fifty years ago which were unstable at temperatures above 122° F (9).

Water alkalinity. Enzymes are produced now to achieve optimum activity at pH 9 to 12, common in home laundry situations (5). McCabe (17) stated that the enzyme laundry products available today work within the pH range of 8-11. At a temperature of 100° F after forty minutes of exposure, one particular enzyme used, showed over 80 per cent activity at pH 9 to 10 (5). Another enzyme exhibited residual activity of 60 per cent after eighteen hours exposure at pH 10 and temperature of 99° F, as opposed to 15 per cent activity for a neutral proteinase enzyme not used in laundry products (9). Another manufacturer states his product is active within a

pH range of 9.5-10 (18). In a report by Langguth and Mecey (16) when the pH was raised above 10.3 by addition of detergent additives, the performance of the enzyme in detergent formulations decreased.

Water temperature. The water temperature used for either soaking or washing is also a determining factor in the performance of enzymes. Most of the enzymes used in products available on the market experience no reduction in performance until the water temperature has gone above the normal hot water range of 120-130° F (18). Usually the enzymes increase their activity until 140° F is reached (6). Action of the enzymes is completely inactivated and irreversible when the temperature of the solution reaches 158° F (6). One of the enzymes used reaches its optimum activity of over 80 per cent when the temperature is between 122-140° F at pH 8.5 after forty minutes of exposure (5).

Detergent additives. Manufacturers are selective in their use of various detergent additives when producing enzyme detergents. The addition of varying amounts of concentrations of anticorrosion agents, soil redeposition agents, fluorescent whiteners, bacteriostats, and bleaches affected the performance of an enzyme in a detergent formulation (16). The performance of the enzyme increased or decreased depending on the amount of additive present. Tests indicate that ingredients which are detrimental to enzymes performance

include those which are high in alkalinity, cationic ingredients and oxidizing agents (16). Use of chlorine bleaches with an enzyme laundry product will deactivate the enzymes (2, 18), although the use of a perborate bleach will have no detrimental effect (17, 18).

Contact time. Length of time that enzymes are allowed to work also affects performance. The longer the contact time between the enzyme solution and the stained garment the greater will be the degree of digestion of the stain (5). Most manufacturers recommend an overnight soaking period or a minimum of one-half hour (6, 17).

The two types of enzyme-active laundry products vary in their length of contact with the stained garment. The enzyme detergents are used in the washer in place of regular detergents and have a short contact time (17). The enzyme pre-soak products are used primarily to soak soiled garments (17). Pre-soaking in an enzyme detergent is also possible. Depending on the length of time the homemaker chooses to allow for soaking, the pre-soaks usually have more contact time than the detergents. The pre-soaks may also be added to the washer with a detergent. Choosing the type of enzyme product to use will depend on the stain and the length of time necessary for removal.

Studies of effectiveness

In a test by a manufacturer using standardized cloth

swatches stained with blood, milk, and ink, addition of less than 0.2 per cent enzyme to a detergent formulation resulted in cleaning efficiency increasing from 56 per cent to 73 per cent. With addition of 0.7 per cent enzyme, 78 per cent cleaning efficiency was reached. The stained swatches were washed in a "Teg-O-Tometer" for ten minutes at 122° F (19). It was not indicated if any of the stains were completely removed.

Other than the manufacturers reported effectiveness of enzyme products, reports of only two independents studies were found in the review of literature; Consumer Bulletin and Consumer Report.

Tests conducted by Consumer Reports (2) indicated that the most significant improvement in appearance of stained clothes was achieved by soaking before normal laundering in either an enzyme pre-soak or a popular detergent. The simple process of soaking was instrumental in removal of some stains not removed during laundering, especially in cotton fabrics. Longer soaking periods, such as overnight, were more effective than shorter periods. It was noted that soaking in an enzyme-active product was not very effective in removing stains such as ballpoint ink, tea, grape juice, and grease stains from durable press articles. Removal of grass stains and mustard stains was improved when they were soaked overnight, as compared to soaking in a regular laundry detergent solution. Blood stains were also easier to remove when soaked with an enzyme pre-soak product.

Consumer Bulletin (12) reports that pre-soaking with a popular laundry detergent was relatively as effective in stain removal as pre-soaking with two enzyme pre-soaks. All three products removed cooked egg yolk stains after soaking for thirty minutes in a cold water solution, and spaghetti sauce after soaking overnight. After overnight soaking, most of the grass, syrup, coffee and tea stains were removed. Although blood stains were removed completely by all three products tested, use of enzyme pre-soaks reportedly provided brighter samples. Overnight soaking with the enzyme pre-soaks removed more of the gravy stains than soaking with the detergent.

Mooney (18) stated that garments stained with chocolate, beef, prunes, plums and gravy were cleaner after overnight soaking with an enzyme pre-soak than when soaked with a regular detergent. He also stated that liver and blood stains were removed better when laundered with an enzyme detergent as compared to a regular detergent.

Summary

It was estimated that by the beginning of 1970 from 45-50 per cent of heavy duty detergent formulations available in the United States will contain enzymes (14). With this great influx of enzyme products there is very little else for the housewife to choose from. The performance of the enzymes in laundry products has been studied and conditions for

maximum performance have been stated by the manufacturers and developers. Little conclusive evidence has been formulated on the actual effectiveness for stain removal and for cleaning laundry though.

PROCEDURE

Sample

The questionnaire was given to homemakers who were members of Extension Homemakers Units (EHU), so that information resulting could be used in formulating an educational program on enzyme products and their use in stain removal procedures. Members of EHU's in Pawnee County, Kansas, were chosen to participate in the survey. Permission to present the questionnaire at the local unit meetings was received from the County Extension Home Economist. There are eleven units in Pawnee County with a total membership of approximately 200. Five of the eleven units were selected to participate in the survey. Several units were eliminated due to large number of older members, conflicts in unit programs, and meeting dates. An attempt was made to choose units with a greater number of young homemakers since it was felt that the younger homemaker with pre- or school-age children would encounter more of the stains listed in the questionnaire than homemakers with grown families. From the five units a total of fifty-four homemakers completed the questionnaire.

Development of questionnaire

After reviewing the pertinent literature and formulating the objectives of the study (see page 1) a questionnaire was developed and given to a number of graduate students and faculty of the College of Home Economics, Kansas State

University, for comments and suggestions. Several revisions to the questionnaire resulted. Pre-testing of the revised questionnaire was done with an EHU in Rush County, Kansas. Further revisions to make wording of questions clearer were made to obtain the final questionnaire. A copy is Appendix A, page 35.

Stains specified in the questionnaire were selected because manufacturers of enzyme products list them as stains ordinarily difficult to remove but capable of being removed by enzyme products. The two independent studies on effectiveness of enzyme products included these stains in evaluating their performance.

The introduction to the questionnaire contained an explanation of the two types of enzyme products available: detergents and pre-soaks. Brand names of each type were listed. A survey of stores in Larned, Kansas, (the only city over 2500 pop. in Pawnee County) was made to determine which brands were available to the participants. This was done to be sure the respondents knew which specific products they should consider when answering the questions.

Administration of questionnaire

Since the questionnaire was administered in person to the five units, the respondents could ask questions if necessary. A statement which appears in Appendix B was made to the unit members before the questionnaires were handed out.

The women spent between fifteen to thirty minutes in completing the questionnaire.

Analysis of data

A descriptive analysis of data was made. Responses were tabulated as percentages so that comparisons could be made according to the various personal characteristics of respondents. Percentages which ended in .5 or more were increased to the next whole number; those ending in less than .5 per cent were dropped.

RESULTS AND DISCUSSION

Personal characteristics of respondents

A total of fifty-four women participated in the survey. Of these, two had never used an enzyme laundry product, and were not considered in tabulating the responses. In answering the questions, some women gave multiple responses, and others did not respond, therefore the percentages did not always total 100.

Responses on residence, occupation of husbands and wives, age of husband and wife, and average family income are reported in Table I, page 16. Some of the fifty-two respondents did not answer all the questions. Following are the number of respondents who did not answer questions concerning: residence--5 (9 per cent), occupation of husband--13 (24 per cent), age of husband--9 (17 per cent), age of wife--4 (7 per cent), average family income--16 (31 per cent). This non-response affects the percentages obtained when determining effectiveness of products for various characteristics, such as residence, income, occupation, age, equipment used, and age of children in family.

Introduction of enzyme products

A majority of the respondents had learned of enzyme laundry products from more than one source at approximately the same time. This is shown by the percentage of responses totaling well over 100. However, advertisements in mass media

TABLE I

SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE

Characteristics	Respondents	
	Number	Per cent
Residence		
farm	35	68
rural non-farm	11	21
urban*	4	2
Occupation of husband		
farmer	23	44
farmer-stockman+	5	10
farmer-other partime job+	4	8
non-farm	6	12
retired	1	2
Wives employed outside home	3	6
Age of husband		
under 35	9	18
35 to 60	27	52
over 60	7	13
Age of wife		
under 35	12	23
35 to 60	27	52
over 60	9	18
Average yearly income		
under $3,000.	4	8
$3,000. to $6,000.	10	19
$6,000. to $10,000.	12	23
over $10,000.	10	19

* lived in city of 5001 population
\+ are not included in farmer catagory

were the most frequent means of introducing the enzyme-active products to the women (Table II, page 18). Radio and television advertisements accounted for 65 per cent and magazines and newspapers, 17 per cent. Over three-fourths, said they first learned of enzyme-active products by receiving a sample through the mail. This was the largest percentage for any single source. Approximately one-fourth, were first told about the products by friends or neighbors. Advertising displays in stores and Extension newsletters accounted for other informational contacts.

The factor being most influential in purchasing an enzyme product was advertisements in the mass media; opinions of friends and relatives ranked second (Table III, page 18). Other factors influencing purchase of products were the product's being on sale, displays in stores, product label, results of samples, sales personnel, and curiosity.

Use of products

Pre-soaks. Of the fifty-two respondents, 92 per cent at one time had used an enzyme pre-soak product (Table IV, page 20). At present 78 per cent were using one of these products. An enzyme pre-soak can be used for soaking stained and soiled garments before laundering, or it can be used as an additive to the detergent in the washer. Over three-fifths of the women used the pre-soaks for soaking stained garments, while 6 per cent indicated they soaked all their laundry in

TABLE II

INTRODUCTION OF ENZYME PRODUCTS BY SOURCE OF INFORMATION

Type of Information	Respondents	
	Number	Per cent
Mailed sample	40	77
TV or radio advertisements	34	65
Friends or relatives	12	24
Newspaper or magazine advertisements	9	17
Store displays	8	15
Extension newsletters or bulletins	3	5

TABLE III

SOURCES OF INFORMATION THAT INFLUENCED PURCHASE OF ENZYME PRODUCTS

Type of Information	Respondents	
	Number	Per cent
Ads in papers, magazines, TV or radio	21	40
Friends or relatives	18	35
Products on sale	7	13
Store displays	5	10
Reading labels	3	6
Sales personnel	1	2
Other	5	10

an enzyme pre-soak. Over one-half of those currently using a pre-soak used them as an additive in the washer. Although this procedure might be quite effective for removal of some stains and light soil, or to produce a brightening effect, it would not be effective for removal of heavier stains and soils.

Detergents. Eighty-one per cent (42) of the women had used an enzyme detergent at one time (Table V, page 20). Seventy-three per cent of all respondents were presently using an enzyme detergent. Eight per cent of the women using enzyme detergents used them only for stained garments. The remaining 92 per cent used them for all their laundry. One woman indicated she especially liked the detergents for permanent press colored clothes as well as for other garments.

Of the 35 women using an enzyme detergent for all their laundry, 17 indicated they also used a pre-soak as an additive to the washer when laundering. This would mean they were using two products, when either one or the other should be sufficient. Using the enzyme detergents and enzyme pre-soaks in this manner would add to the cost of laundering.

Of those who had tried an enzyme pre-soak, 14 per cent did not continue to use them. This compares to 8 per cent of those discontinuing use of an enzyme detergent.

Effectiveness of enzyme products

Pre-soaks. A total of 83 per cent of the women questioned

TABLE IV

ACCEPTANCE AND PRESENT USE OF ENZYME PRE-SOAK PRODUCTS

Pre-soak use	Respondents	
	Number	Per cent
Used at least once	48	92
Used currently	41	78
for soaking stains	26	63*
for soaking all laundry	3	7*
with detergent in washer	21	51*

*Per cent of those currently using enzyme pre-soaks.

TABLE V

ACCEPTANCE AND PRESENT USE OF ENZYME DETERGENT PRODUCTS

Detergent use	Respondents	
	Number	Per cent
Used at least once	42	81
Used currently	38	73
for stains	3	8*
for all laundry	35	92*

*Per cent of those currently using enzyme detergents.

said there was improvement in stain removal when a pre-soak was used in some manner (Table VI, page 22). Of those using a pre-soak, 46 per cent felt there was improvement in stain removal. Thirty-seven per cent said improvement in stain removal was obtained when stained garments were soaked in an enzyme pre-soak solution. A total of 7 per cent said using a pre-soak produced no noticable difference or was less effective in stain removal.

In comparing families with no children at home and families with children, those with children under six felt pre-soaks were more effective if soaking was done before laundering. Fifty per cent of families with children age six to eighteen felt there was an improvement, without qualification, in stain removal when a pre-soak was used, as compared to 47 per cent for families with no children at home and 27 per cent for families with at least one child under six (Table IX, Appendix C, page 43). A larger percentage (55 per cent) of families with at least one child under six than with no children at home or with children between the ages of six and eighteen, felt there was improvement in stain removal only with soaking.

Of the families using an automatic washer for home laundry, 35 per cent indicated unqualified improvement in stain removal with use of a pre-soak product; 40 per cent indicated improvement if soaking was done (Table X, Appendix C, page 44). Of three respondents who did not use an automatic washer at home,

TABLE VI

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS

Type of Laundry Improvement Observed	Pre-soaks N = 41		Detergents N = 38	
	No.	%	No.	%
Improvement in stain removal	19	46	34	89
Improvement in stain removal with soaking	15	37	1	3
No noticable difference in stain removal	2	5	4	11
Less effective stain removal	1	2	1	3
No response	2	5	2	5

two-thirds said using a pre-soak was an improvement. This small group gives no indication that preference for soaking is related to the type of equipment used for laundry.

Differences in the families with incomes of $3,000. to $6,000., $6,000. to $10,000. and over $10,000. was slight with 50, 43, and 50 per cent respectively, indicating soaking resulted in improvement in stain removal. A smaller group of those with income under $3,000. (25 per cent) indicated that soaking stained garments resulted in improvement in stain removal (Table XI, Appendix C, page 45).

There were only slight differences in the reported effectiveness of pre-soaks when farm and rural non-farm residents were compared (Table XII, Appendix C, page 46). However, a slightly higher percentage of farm families did report improvement in laundry results with use of pre-soaks than non-farm families.

When effectiveness of pre-soaks were compared according to occupation of husband, it was found that 38 per cent of families with farm-related jobs found a general improvement in stain removal while 47 per cent reported improvement with soaking. Fifty per cent of respondents with husbands in non-farm jobs reported improvement as a whole while another 17 per cent found improvement when soaking garments (Table XIII, Appendix C, page 47). When both Table XII and XIII are considered it appears farm families were more satisfied with using a pre-soak product than were families not involved in

farm activities.

A larger proportion of the younger wives (under 35), as compared to those age 35 to 60 and over 60, indicated there was improvement in stain removal action only if stained garments were soaked (Table XIV, Appendix C, page 48).

Detergents. Of the thirty-eight respondents currently using an enzyme detergent, 89 per cent said they resulted in an improvement in stain removal (Table VI, page 22). Fourteen per cent said they did not see any improvement when using an enzyme detergent.

Of the women using an enzyme detergent little difference could be shown when they were grouped by age of children in family, equipment used, average family income, residence, occupation of husband, or age of wife (Table IX through XIV, Appendix C, pages 43-48).

Additional comments. Thirteen women made additional comments concerning their experiences with either the enzyme pre-soaks or enzyme detergents. Two commented that the enzyme products were very helpful in removing grass and mud stains from football uniforms. One used a pre-soak and soaked the stains overnight in hot water. The other found that soaking overnight in warm water with an enzyme detergent was effective. The wife of a dairy farmer reported that pre-soaks were effective for removing grease and milk stains from overalls. One mother of three children under 2½ years said the enzyme

TABLE VII

STAIN REMOVAL METHODS

Procedure for stain treatment	Respondents	
	Number	Per cent
Consulted stain removal chart	21	40
Recalled previous experience	21	40
Trial and error	12	24
Treat garment soon after staining	30	58
Delayed treatment of stained garment	16	31

products were effective for removing formula stains if soaked thirty minutes in warm water.

One woman felt the enzyme products gave a better looking wash with her automatic washer. She felt the automatic washer was not cleaning as her old machine had.

Some of the complaints were: a disagreeable odor which remained after using a pre-soak, the expense, and poor results with a particular brand. One woman reported enzyme products had not removed black licorice from garments.

Methods of stain removal

The responses on choosing methods of stain removal indicate an equal number, 40 per cent, used stain removal charts and previous experience in determining what method to use in removing a particular stain. Twenty-three per cent used trial and error to remove stains. Fifty-eight per cent treated stains soon after staining occurred, while 31 per cent did not.

Responses as to whether the women used enzyme products to soak stains to aid in stain removal are recorded in Table VIII, page 27. The approximate length of time garments were soaked were divided into three categories; less than one-half hour, one-half hour to eight hours, and eight hours or more. None soaked stained garments longer than overnight. Of stains listed, blood and grass were ones most frequently soaked. The treatment they used most for blood stains was a short soak

TABLE VIII

TREATMENT OF STAINS WITH ENZYME PRODUCTS

Types of Stains	Stains difficult to remove		Use enzyme product for removal		Soaking Time: less than ½ hr.		Soaking Time: ½ hr. to 8 hrs.		Soaking Time: 8 hrs. to overnight		Water Temperature: Hot		Water Temperature: Warm		Water Temperature: Cold	
	Total Respondents				Respondents using enzymes for stain removal											
	no.	%*	no.	%*	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Blood	24	46	32	62	18	57	7	22	7	22	2	6	7	22	23	72
Grass	24	48	14	27	2	14	3	21	9	64	4	29	8	57	2	14
Fruit Juices	5	10	9	18	6	67	2	22	1	11	6	67	2	22	1	11
Chocolate	13	25	9	18	4	44	2	22	3	33	1	11	4	44	4	44
Coffee	3	6	7	13	5	71	-	-	2	29	2	29	3	43	2	29
Mustard	6	12	6	12	4	67	1	17	1	17	-	-	4	57	3	43
Gravy	3	6	3	6	2	67	-	-	1	33	1	33	2	67	-	-
Diaper stains	2	4	3	6	-	-	-	-	3	100	1	33	1	33	1	33

* Per cent of total respondents - 52.

period of less than one-half hour in cool water. For grass stains they soaked in warm water for eight hours or overnight. Fruit juices and chocolate were reported as next in frequency of stains soaked. For removal of fruit juices, a short soak period of less than one-half hour in hot water was reported most often. Stains soaked for short periods of less than one-half hour were blood, fruit juice, chocolate, coffee, mustard and gravy. Long soaking periods of eight hours or overnight were felt necessary to treat grass stains, and diaper stains. The moderate time period was not used most often for any of the specified stains. The women seemed to agree relatively well on the water temperature for soaking each stain. Hot water was used by the majority (67 per cent) for only fruit juice stains; warm water was used most frequently for grass, coffee, mustard and gravy stains. Cold water was used most often for soaking blood. Of the three soaking diaper stains each of the three water temperatures were used by one. Both warm and cold water were used by 44 per cent of the women soaking chocolate stains.

SUMMARY

The majority of the women were currently using either an enzyme pre-soak or an enzyme detergent. Introduction of the enzyme products was through mass media or mailed samples. Mass media also influenced 40 per cent of the respondents to purchase an enzyme product. Of the forty-one respondents using a pre-soak, 63 per cent soaked garments and 51 per cent added it with detergent to the washer. Overall improvement in stain removal was reported by 46 per cent of those using a pre-soak. Improvement in stain removal was reported by 46 per cent of those using a pre-soak. Improvement in stain removal with soaking was reported by 37 per cent. Ninty-two per cent of the thirty-eight women currently using an enzyme detergent used it for all laundry. Of those using an enzyme detergent, 89 per cent indicated an improvement in stain removal. Percentages calculated to compare opinions about effectiveness of enzyme products by personal characteristics of the sample do not necessarily reflect the opinions of the entire sample since all respondents did not fill in personal data on the questionnaire.

When using an enzyme product for soaking stains the women either used a short soak period of less than one-half hour or a long soak period of eight hours to overnight depending on the degree of difficulty in removing the stain. Water temperature used for soaking depended on the stain except for diaper stains which were equally divided between

hot, warm, and cold water. The majority of the women treated stains soon after they occurred.

Of those who had tried an enzyme pre-soak, 14 per cent did not continue to use them. This compared with 8 per cent of those discontinuing use of an enzyme detergent. Results did not indicate why slightly more of the homemakers continued to use enzyme detergents than enzyme pre-soaks, when a greater percentage reported better stain removal with use of a pre-soak product. Availability of pre-soaks or extra time and expense necessary for pre-soaking may have influenced their continued use of these products.

The women using a pre-soak product as a additive to their regular detergent in the washer, were not utilizing the product to its full advantage. The pre-soak products were designed for a longer contact period than would be obtained in the wash cycle. Using both an enzyme pre-soak and an enzyme detergent in the washer would add to the cost of laundering without a corresponding improvement in the laundry.

Although some general statements on the use of enzyme products and their effectiveness have been made, the small size of the sample, specificity of sample, and lack of statistical analysis make it impossible to draw specific conclusions about reported effectiveness and use of enzyme products or generalization of these results to all women. However, indications of how these women have reacted to the enzyme products can be helpful in planning further studies

or educational programs. The results reported are the homemakers' opinions of enzyme products' effectiveness and should not be interpreted as evidence that enzymes improve stain removal.

Recommendations for an educational program based on results of this survey would include information on physical factors which can be controlled by the women (water temperature and contact time), and their effect on enzyme performance; as well as correct methods for removal of specific stains.

Further laboratory tests on actual effectiveness of enzyme products for stain removal are recommended. Further surveys on specific stains homemakers treat with enzyme products, and the frequency of use of enzyme products are also recommended.

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APPENDIX A

QUESTIONNAIRE

The enzyme-active laundry products on the market are on two groups.

A. Enzyme-active pre-soaks are used primarily to soak soiled garments before washing. The soak period may last from several minutes to overnight. After soaking, the garments are then washed in the usual manner with your usual laundry detergent.

Examples include: Amaze, Biz, Axion, Sure

B. Enzyme-active detergents are used in the washer in place of your usual laundry detergent. They are laundry detergents to which the manufacturer has added enzymes.

Examples include: Ajax, Bold, Cold Power, Drive, Fab, Gain, Oxydol, Punch, Tide XK

THE FOLLOWING QUESTIONS ARE CONCERNED WITH YOUR AWARENESS OF AND INTRODUCTION TO THE ENZYME-ACTIVE LAUNDRY PRODUCTS.

1. Have you tried any of the enzyme-active laundry products, such as those mentioned above?

   Yes____ No____

2. How did you first learn of the enzyme-active laundry products?

   advertisements on TV or radio_____

   advertisements in newspapers or magazines_____

   displays in stores_____

   received samples thru mail_____

   heard about from friends or relatives_____

   Extension newsletters or bulletins_____

   other sources (name)_____

3. If you have bought an enzyme-active laundry product, what influenced you to do so? Please check sources that influenced you most.

sales persons_____

friends or relatives_____

Extension personnel_____

ads in papers, magazines, TV or radio_____

displays in stores_____

reading the label on the products_____

products were on sale_____

other sources (name)_____

THE FOLLOWING QUESTIONS ARE ABOUT YOUR REACTIONS TO THE ENZYME-ACTIVE PRE-SOAK LAUNDRY PRODUCTS.

Examples of pre-soaks are: Amaze Biz
Axion Sure

4. Have you ever used an enzyme-active pre-soak laundry product?

Yes____ No____

If no, skip questions number 5 and 6 and go on to 7.

5. Are you now using an enzyme-active pre-soak laundry product?

No_____

Yes, for soaking stains_____

Yes, for soaking all laundry_____

Yes, along with detergent in washing machine____

6. Do you find an enzyme-active pre-soak laundry product usually results in an improvement over your old laundry methods for stain removal?

Yes, but only if stain is soaked_____

Yes, it is an improvement_____

No, there is no difference_____

No, it is less effective_____

THE FOLLOWING QUESTIONS ARE ABOUT REACTIONS TO THE ENZYME-ACTIVE LAUNDRY DETERGENTS WHICH YOU MAY HAVE TRIED?

Examples of detergents are: Ajax Bold Cold Power
Drive Fab Gain
Oxydol Punch Tide XK

7. Have you ever used an enzyme-active laundry detergent?

Yes____ No____

If no, skip questions number 8 and 9 and go on to 10.

8. Are you now using an enzyme-active laundry detergent?

No_____

Yes, for stains_____

Yes, for all laundry_____

9. When you use an enzyme-active laundry detergent product, do you find they usually result in an improvement over your old laundry methods for stain removal?

Yes, it is an improvement_____

No, there is no difference_____

No, it is less effective_____

THE FOLLOWING QUESTIONS DEAL WITH SPECIFIC STAINS AND THE METHODS USED FOR REMOVAL.

10. The stains listed below are usually considered difficult to remove. Of the ones you encounter, please check the one which you find most difficult to remove.

blood_____ diaper stains_____

mustard_____ fruit juices_____

coffee_____ chocolate_____

grass_____ gravy_____

11. How do you decide what method to use in removing a particular stain?

stain removal chart_____

trial and error_____

previous experience_____

12. Do you normally treat garments soon after staining occurs?

Yes____ No____

13. If you soak any of the following stains in an enzyme-active pre-soak or an enzyme-active detergent, please indicate how long you usually soak and whether hot, warm or cold water is used.

STAIN	APPROXIMATE TIME	WATER TEMPERATURE HOT WARM COLD
blood	_____	_____
mustard	_____	_____
coffee	_____	_____
grass	_____	_____
diaper stain	_____	_____
fruit juices	_____	_____
chocolate	_____	_____
gravy	_____	_____

14. If you have any further comments about the enzyme-active laundry products, please write them in the space below.

_____

_____

_____

_____

_____

GENERAL QUESTIONS

Residence--urban (over 2500 pop.)_____

rural non-farm (under 2500 pop.)_____

farm_____

Occupation of husband_____

Occupation of wife if other than housewife_____

Total family income (last year) under $3,000___ $3,000 to $6,000___

$6,000 to $10,000___ over $10,000_

Age of husband--under 35___, 35 to 60___, over 60___.

Age of wife--under 35___, 35 to 60___, over 60___.

Number and age of children at home--under 2½ years _____

2½ to 6 years_____

6 to 12 years_____

13 to 18 years_____

over 18 years_____

Equipment normally used for doing laundry

wringer type washer_____

automatic washer in home___

laundromat_____

automatic dryer_____

other (specify)_____

APPENDIX B

STATEMENT TO RESPONDENTS

This questionnaire was designed as a part of a Master's Report for a Master's Degree at Kansas State University. The questions are about your opinions and reactions to the enzyme-active laundry products which were introduced on the market about 2 years ago. The first part of the questionnaire tells about the two types of enzyme-active laundry products available, the pre-soaks and the detergents. Please read it carefully and then fill out the questionnaire as best you can. If you have not used any of the products, please return the questionnaire. Thank you very much for your cooperation on this project.

APPENDIX C

TABLE IX

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO AGE OF CHILDREN IN FAMILY

Respondents reported effectiveness	Families with at least one child under age six N=11				Families with children age six to eighteen N=16				Families with no children at home N=17				Total N=44			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	3	27	9	82	8	50	13	81	8	47	13	76	19	43	35	78
Improvement in stain removal with soaking	6	55	-	-	6	38	-	-	8	47	-	-	20	45	-	-
No noticable difference in stain removal	2	18	1	9	1	6	1	6	-	-	2	11	3	7	4	9
Less effective stain removal	-	-	-	-	1	6	-	6	-	-	-	-	1	2	1	2
No response	-	-	1	9	-	-	-	6	1	6	2	12	1	2	4	9

TABLE X

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO EQUIPMENT USED FOR LAUNDRY

Respondents reported effectiveness	Families using a laundromat N=1				Families using a wringer type washer N=2				Families using an automatic washer N=13				Families using an automatic washer and dryer N=32				Total N=48			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	-	--	1	100	1	50	-	--	6	46	7	53	10	31	25	78	17	35	34	71
Improvement in stain removal with soaking	1	100	-	--	-	--	-	--	4	30	-	--	14	44	--	--	23	48	--	--
No noticable difference in stain removal	-	--	-	--	-	--	1	50	-	--	2	15	3	9	1	3	3	6	4	8
Less effective stain removal	-	--	-	--	-	--	-	--	-	--	-	--	1	3	1	3	1	2	1	2
No response	-	--	-	--	1	50	1	50	3	23	4	30	4	13	5	16	8	17	10	21

TABLE XI

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO AVERAGE YEARLY FAMILY INCOME

Respondents reported effectiveness	Income of less than $3,000. N=4				Income of $3,000. to $6,000. N=10				Income of $6,000. to $10,000. N=14				Income over $10,000. N=10				Total N=38			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	2	50	3	75	3	30	7	70	5	36	11	79	3	30	7	70	13	34	28	74
Improvement in stain removal with soaking	1	25	-	--	5	50	-	--	6	43	--	--	5	50	-	--	17	45	--	--
No noticable difference in stain removal	-	--	1	25	1	10	1	10	1	7	1	7	1	10	2	20	3	8	5	13
Less effective stain removal	-	--	-	--	-	--	-	--	-	--	--	--	1	10	-	--	1	3	--	--
No response	1	25	-	--	1	10	2	20	2	14	2	14	-	--	1	10	4	10	5	13

TABLE XII

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO RESIDENCE

Respondents reported effectiveness	Farm N=35				Rural non-farm N=11				Urban N=1				Total N=46			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	11	31	27	77	3	27	5	45	1	100	1	100	15	33	32	70
Improvement in stain removal with soaking	16	46	--	--	4	36	--	--	--	--	--	--	20	43	--	--
No noticable difference in stain removal	2	6	3	9	1	9	2	18	--	--	--	--	3	7	3	7
Less effective stain removal	1	3	--	--	1	9	--	--	--	--	--	--	2	4	--	--
No response	5	14	5	14	3	27	4	36	--	--	--	--	8	17	9	20

TABLE XIII

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO OCCUPATION

Respondents reported effectiveness	Farm related N=32				Non-farm related N=6				Total N=38			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	12	38	24	75	3	50	4	67	15	40	28	74
Improvement in stain removal with soaking	15	47	1	3	1	17	--	--	16	42	1	3
No noticable difference in stain removal	2	6	2	6	1	17	1	17	3	8	3	8
Less effective stain removal	1	3	1	3	--	--	--	--	1	3	1	3
No response	2	6	4	13	1	17	1	17	3	8	5	13

TABLE XIV

REPORTED EFFECTIVENESS OF ENZYME PRODUCTS ACCORDING TO AGE OF WIFE

Respondents reported effectiveness	under 35 N=12				35 to 60 N=27				over 60 N=9				Total N=48			
	Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent		Pre-soak		Detergent	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Unqualified improvement in stain removal	2	17	6	50	13	48	27	81	2	22	5	55	17	35	33	69
Improvement in stain removal with soaking	7	58	1	8	9	33	-	-	3	33	-	-	19	40	1	2
No noticable difference in stain removal	1	8	1	8	2	7	2	7	-	-	-	-	3	6	3	6
Less effective stain removal	-	-	1	8	1	3	-	-	-	-	-	-	1	2	1	2
No response	2	17	3	25	2	7	3	11	4	44	4	44	8	17	10	21

ENZYME-ACTIVE LAUNDRY PRODUCTS: REPORTED USE AND EFFECTIVENESS BY SELECTED GROUP OF WOMEN

by

REITA BETH WILSON

B.S., Kansas State University, 1966

AN ABSTRACT OF A MASTER'S REPORT

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Functions and types of enzymes used in laundry products, physical factors affecting performance, and the use and effectiveness of enzyme products as viewed by Extension Homemaker Unit members in Pawnee County, Kansas, were discussed.

The majority of the women were currently using either an enzyme pre-soak or an enzyme detergent. Introduction of enzyme products was through mass media or mailed samples. Mass media influenced 21 of 52 respondents to purchase an enzyme product. Of the 41 using enzyme pre-soaks, 26 soaked garments and 21 added them to the washer. Overall improvement in stain removal was reported by 15, only if garments were soaked before laundering. Of 38 women using enzyme detergents, 35 used them for all laundry and 34 indicated an improvement in stain removal.

When using an enzyme product for soaking stains, a short soak period of less than one-half hour or a soak period of eight hours or more was used, depending on the stain. Water temperature used for soaking depended on the stain, also. The majority of the women treated stains soon after they occurred.

Results indicate that a large proportion of respondents used enzyme products for laundry and stain removal and found improvement in laundry appearance. The particular stains determine if soaking will be done and the time and water temperature to be used.