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Application of Anti-Bacterial Feature to Wet Wipes Made of Cellulosic Fibre Based

Osman Yayla*, Mustafa Özgeç, Ersan Ay, Ümit Gençtürk, Azize İnce

Pakten Health Products Inc., R&D Center, 27650 Gaziantep, Turkey.

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Abstract: Nonwoven wipes can be divided into two main types: consumer and industrial. Consumer wipes include baby wipes, personal care wipes, skin cleansing wipes, and home or home care wipes, while industrial wipes are divided into general purpose, specialty, food service and health wipes. After the production of the first baby wipes in the 1970s, the wet wipes sector, which grew with the expansion of the market, started to be used in many areas in the mid-1990s. It continues to grow rapidly today with softer products with higher cleaning and protection performance. The environment where our hands are in frequent contact has a rich microbial flora. It is very important to clean our hands daily, which contain the most microorganisms. It is stated that the priority for proper hand hygiene according to experts is to wash the hand with soap and water. In cases where washing with soap and water is not possible, hand cleaning with antibacterial wet wipes or hand disinfectants is recommended. In this study, it was aimed to create antibacterial wet wipes by adding benzalkonium chloride in different concentrations to natural fiber-based spunlace nonwovens. The antibacterial effectiveness of wet wipes has been tested according to TS EN 1276 standard. Escherichia coli (ATCC 10536), Pseudomonas aeruginosa (ATCC 15442), Enterococcus Hirae (ATCC 10541) and Staphylococcus aureus (ATCC 6538) bacterial applied in accordance with the test standard were determined to be eliminated at a rate of 99.9% after 1 minute. Within the scope of the study, the effect of antibacterial wet wipe on the skin was examined according to the OECD TG 439 test standard and it was observed that it did not cause any irritation on the skin.

Key words: Benzalkonium Chloride, Bacteria, Antibacterial, Wet Wipes

1. Introduction

Wet wipes consist of non-woven fabrics. Nonwoven fabrics are structures or webs in which fibers are mechanically, thermally or chemically bonded. Since porous fabric structures consist directly of fiber or molten polymer, the fibers do not need to be converted into yarns to form bonds [1]. To date, the only internationally recognized definition for nonwovens has been included in the EN ISO 9092 standard. Nonwoven fabrics are defined in the EN ISO 9092 standard as follows *"A nonwoven is an engineered fibrous assembly, primarily planar, which has been given a designed level of structural integrity by physical and/or*

Corresponding author: osman.yayla@pakten.com

chemical means, excluding weaving, knitting or papermaking" [2]. Today, international industry associations serving the nonwoven industry, INDA (International Nonwovens and Disposables Association) and EDANA (European Disposable and Nonwovens Association), proposed the following text to the International Organization for Standardization (ISO): *"A nonwoven is a sheet of fibres, continuous filaments, or chopped yarns of any nature or origin, that have been formed into a web by any means, and bonded together by any means, with the exception of weaving or knitting. Felts obtained by wet milling are not nonwovens"* [3]. These wipes can be classified as disposable products or products for longer use. These wipes are sold as dry wipes or as a wet wipe (containing lotion).

They can also be distinguished by their intended use as personal care diapers (personal hygiene including diapers, household cleaning, etc.) and industrial wipes. Nowadays, wet wipes are used for many purposes in daily life, especially personal care applications. These products, which provide convenience to users, also save cleaning time.

In addition, as it can be used on the move or at home, it provides fast and practical solutions as well as meeting the increasing hygiene need. The variety and applications of personal care wipes have been increasing in recent years. Most of the wipes are made from blends of synthetic polymers (polyester etc.) and natural fibers (viscose fibers and / or wood pulp). While viscose / wood pulp fibers are highly absorbent and biodegradable, synthetic polymer fibers stand out with their high strength, softer and resistance to solvents [1]. Cleaning and baby wipes used at home consist of highly biodegradable synthetic blended products with high tensile strength and soft texture. However, in cosmetic products, as absorbency is more prominent, flushable fibers are preferred. With the exception of moist toilet wipes (and a small number of other products, such as some toilet disinfectant wipes and some special hygiene wipes), all other wet wipes should be disposed of with household waste according to the package directions [4]. The use of wet wipes was introduced by the American Arthur Julius with Wet-Nap as the first brand of wet wipes in 1963 for distribution to Kentucky Fried Chicken customers [5]. Especially in the 1970s, Kimberly-Clark's Huggies and Procter & Gamble's first wet wipes marketed as Pampers' baby wipes were launched in 1990 and the industry grew rapidly [6]. In 2018, the global nonwoven handkerchief market reached a value of 16.6 billion dollars and 1.2 million tons of nonwoven were consumed. It is thought that this value will increase to 21.8 billion dollars and the nonwoven consumption to 1.6 million tons in 2023 [7]. In the spunlace line, which is the most used method in the production of wet wipes, the nonwoven surface is formed and the environment is watery since the fibers are bound by water jet. The amount of cellulose in the fibers is suitable for microbial growth in appropriate conditions (temperature, humidity) and is a good nutrient. Therefore, microbiological testing of wet wipe products is one of the main features sought for manufacturers [8]. Spunlace non-woven

textile surfaces used in skin cleaning are soft and durable, and the porous structure of their fabrics helps to collect dirt. Since our hands are in constant contact with the environment, they carry a rich microbial flora. Bacteria in the skin of the hand are divided into two categories as temporary and permanent flora. Persistent flora; Most of them are organisms found in the deep layers of the skin, with low pathogenicity and normally not associated with nosocomial infections. The density of bacteria in the permanent flora varies between 102-103 cfu / cm2 and is not affected much by hand hygiene. Temporary flora; It is called microbe flora that can be transferred between human skin and inanimate surfaces by hand contact and can be easily destroyed by washing the hands with water and soap. It plays an important role in the development of nosocomial infections [9]. Benzalkonium chloride (BAC), used as a skin antiseptic, is a caustic agent that is a quaternary ammonium compound, and its concentration ratios vary from 0.005% to 10%. When used in high concentrations, it can cause severe skin burns [10]. Wet wipes machines cut the nonwoven fabric to the desired size and designed shape and bring the wet wipes to the consumer after the packaging process. The operating principle of wet wipes machines, which are simply composed of three units; The nonwoven fabrics that are dryly attached to more than one unwinder unit are folded according to the desired shape in the nonwoven folding unit according to the operator and driving directions. Then the fabric is dipped into a pool filled with solution or the solution is sprayed on the fabric through nozzles. Then the wet wipes are stacked on top of each other according to the desired number of pieces and transferred from the folding unit to the packaging unit by means of moving bands. In the packaging unit, wet wipes from the tape are brought over the PE + OPP / PE + PET film layer fed from a separate winding unit. Wet wipes and packaging are passed through heated discs with conveyor belts and combined with heat treatment from the ends of the package. If a cap is to be added on the package, the plastic caps are adhered to the packaged wet wipes with hot melt glue in the cap unit.

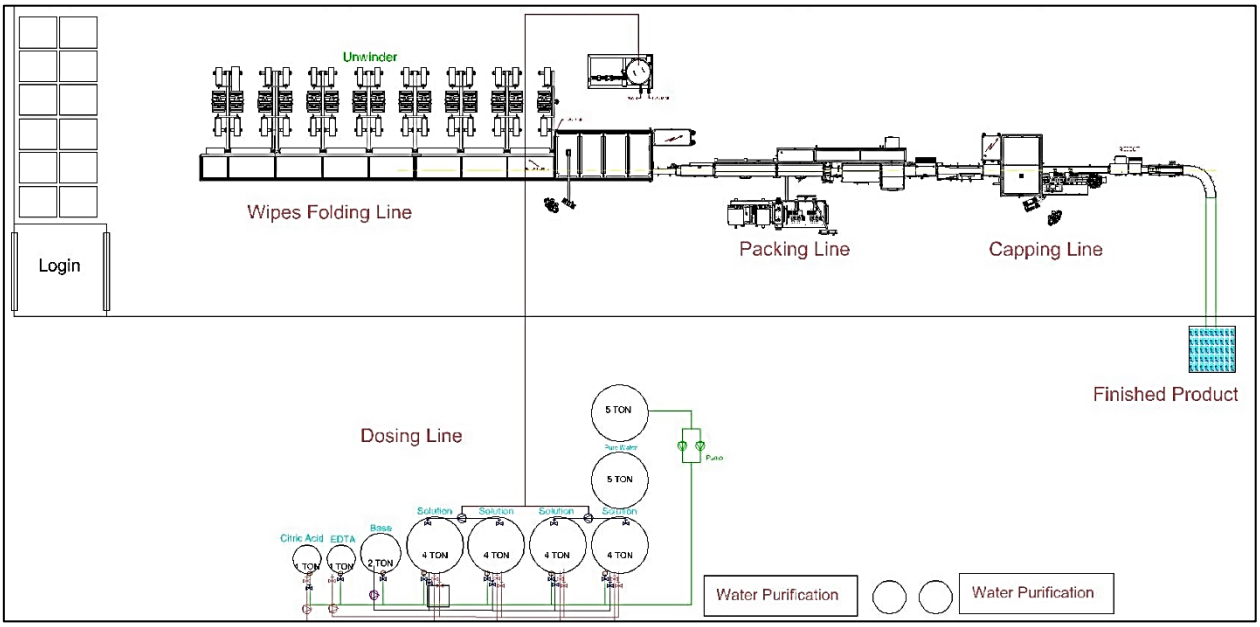


Figure 1. Wet Wipes Production (Autocad Drawing)

In a study investigating disinfectant activities, the effectiveness of ethyl alcohol, povidone iodine and benzalkonium chloride against the microorganism Pseudomonas aeruginosa, which is highly resistant to antibiotics and antiseptics that can grow in any humid environment, was investigated. The effectiveness of the disinfectants was controlled in accordance with the P. aeruginosa ATCC 27853 standards and it was considered as an antiseptic effective, which eliminates 95% of bacteria. As a result; It was found that the three antiseptics used were effective in all P. aeruginosa strains, and there was no difference between groups I and II in terms of sensitivity to antiseptics [11]. In another study conducted by Altuntaş et al., It was determined that the concentration ratio is very important when preparing Benzalkonium chloride disinfectant, which is used as a skin antiseptic. In this context, no findings were found as a result of the examinations and pathological examinations performed in two cases who were examined to determine the cause of the darkening and burns in and around the genital area of two male babies admitted to the neonatal ward. Based on the similarity of the cases, it has been determined that the hospital personnel who perform the skin cleaning of babies are used at a concentration of 10% instead of 0.1% and that the skin burn is caused by Benzalkonium chloride. Benzalkonium chloride is generally a well-known skin irritant and should be used as an irritant at a concentration of 0.5%. Although, it was observed in two cases that it can cause chemical burns when used in high concentrations without dilution [10]. In another study conducted for benzalkonium chloride, the available data were examined to investigate the possible effects of BAC's (Benzalkonium chloride) on human safety and the environment in general. Evidence has been presented in the literature that the continuous use of biocides and their release into the environment in different concentrations can lead to

the emergence of tolerant, resistant or cross-resistant microbial strains. Considering the reported side effects of BAC, it was stated that a comprehensive analysis of the benefits against the risks should be made for the future use of the compound. For the use of BAC in consumer products, the Centers for Disease Control and Prevention (CDC) and FDA recommend some restrictions and it is recommended by consumers (not including professionals in healthcare settings) to use BAC only with water and plain soap. Based on the available data, it was determined that bacteria survive with cross-resistance at different concentrations of BAC (benzalkonium chloride) in the environment. Therefore, further research, both in clinical and environmental contexts, has been encouraged to increase BAC exposure in the microbial population [11]. In another study, it was aimed to reveal the principles of chemical analysis, antibacterial efficacy test and validation studies of benzalkonium chloride (BAC) used as a biocidal disinfectant. It is also the first study of biocidal analyzes performed according to EU standards. The main purpose of this study is to determine and evaluate the content of active substance by chromatographic method LC-MS / MS. It was also said that the study sheds light on the antibacterial efficacy of BAC-containing disinfectants with EN standards. Within the scope of the study, the disinfectant containing BAC at a concentration of 20% was used as a prototype and the active substance content was confirmed by chemical analysis. Following the approval of the active ingredient, microbiological activity tests were performed against E. coli K12, S. aureus, P. aeruginosa and E. hirae bacteria. After 1 minute of contact with the test product, more than 5 logarithmic reductions were obtained against all bacterial strains. The BAC homologs (n-C12 and n-C14) contained in the product were identified and separated by LC-MS / MS method. With these results, the importance of chemical and microbiological analysis of biocidal products before production and marketing has been revealed [12]. Antibiotic prophylaxis, bacterial disease that occurs in the vaginal or rectal area of approximately 10-30% of pregnant women, and the therapeutic role of benzalkonium chloride, which is known to have antimicrobial activity against these bacteria, in vaginal inflammatory infections caused by the growth of GBS has been investigated. For this, a total of 52 GBS strains isolated from the vaginal swabs of pregnant women were taken and tested according to CDC guidelines. All GBS isolates were inhibited or killed by benzalkonium chloride at not only low but very similar concentrations (MIC90 = 3.12 mg / L). Benzalkonium chloride has been found to be beneficial in reducing vaginal GBS colonization before birth with topical therapy in pregnant women [13].

Considering the cost and quality parameters, it is inevitable to reach the optimum antibacterial wet wipes in different concentrations at low cost. In this study, it was aimed to create anti-bacterial wet wipes by adding benzalkonium chloride in different concentrations to cellulosic fiber-based spunlace nonwovens. In this context, antibacterial especially wet wipes were produced by treating 20% Viscose and 80% Polyester

blended spunlace fabrics with two different concentrations of benzalkonium chloride. At the same time, the disinfectant efficiency of 70% Ethyl Alcohol and 20% Sodium Hypochlorite, which are known to be effective on bacteria, was examined and included in the trial systematic. The most effective concentration rate will be determined among the produced wet wipes and the temporary flora on the skin will be completely removed.

Figure 2. Anti-Bacterial Wet Wipes Produced Product Image

2. Materials and Methods

2.1. Antibacterial Wet Wipes Production

The raw material properties used within the scope of the study are given in Table 1. Nonwoven surface mixing ratios were determined as 20% Viscose 80% Polyester.

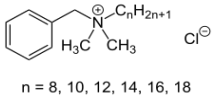
Table 1. Raw Material Properties

Material Properties	Viscose	Polyester
Fibres Thickness (dtex)	1,3	1,64
Fibres Length (mm)	32	38
Density (g/cm^2)	1,5-1,52	1,33-1,38
Strength (cN/tex)	28	50,3
Elongation (%)	19	32

A solution of 0.11% and 0.20% Alkyl (C12-16) dimethyl benzyl ammonium chloride (ADBAC / BKC (C12-16) (Cas No: 68424-85-1) was prepared and applied on wet wipes by impregnation method. 15 * 19 cm ± 1 While the weight of 1 piece of dry wipes in cm dimensions was 1.14 g ± 10%, the required solution

amount for the dry wipe was determined as 3.682 g ± 10%. The amount of 1 dry wipe + solution produced was 4.822 g ± 10% total weight.

Table 2. Antibacterial Substance and Properties

Substance	Degree of Pure (%)	Chemical Formula	Density (g/cm^3)	Molecular Weight (g/mol)	Chemical Expression
ACTICIDE® BAC 50 M	50	$C_6H_5CH_2N(CH_3)2RCl$	0,98	340	 n = 8, 10, 12, 14, 16, 18

Wet wipes from nonwovens containing benzalkonium chloride at different concentrations were produced at wet wipes machines. Controlled productions were carried out by dipping 190 mm sliced bobbins for 20 minutes / package in a solution vessel with a 200 lt reservoir. Trial productions were carried out in an environment where temperature 25 ° C, relative humidity 50%, fresh air (hepafilter) and positive pressure were created.

Table 3. Sample Systematics

Code	Sample	Weight (gsm)	Content	Active Ingredient
B	Bleach	-	-	20% Sodium Hypochlorite
E	Ethyl alcohol	-	-	70% Ethyl Alcohol
C	(Non-Protective) Current Wet Wipes	40 GSM	%80 PES %20 CV	-
S1	Antibacterial Wet Wipes	40 GSM	%80 PES %20 CV	0.11% Benzalkonium Chloride
S2	Antibacterial Wet Wipes	40 GSM	%80 PES %20 CV	0.20% Benzalkonium Chloride

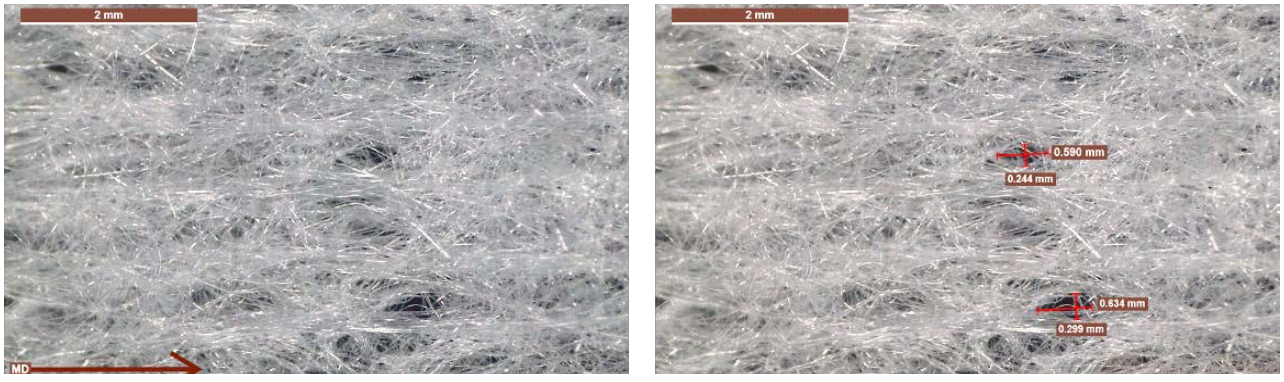


Figure 3. Pattern Image of Spunlace Nonwoven Fabric and Gaps in Fibers (Leica S9i Microscope 10x Magnification)

2.2.Antibacterial Wet Wipes Tests

Table 4. Applied Tests and Standards

Fabric Type	Test Type	Tests and Standards
Raw Fabric	Physical	Weight (NWSP 130.1. R0 (15))
		Thickness (NWSP 120.6. R0 (15))
	Mechanic	Tensile Strength (ISO 13934-1)
		Elongation at Break (ISO 13934-1)
	Liquid Absorption	Water Drop Test (ISO 9073-13: 2001)
Wet Wipes	Stability	Shelf Life
	Physical and Chemical	pH, Viscosity, Density
	Antibacterial Property	Qualitative Disc Diffusion Test TS EN 1276
	Epiderm Tests	Skin Irritation (SIT) (OECD TG 439)
	Subjective	Consumer Test

Determination of grammage as used for grams of 1 m^2, 5 different measurements are made for one experiment and the weights of raw fabrics NWSP 130.1. It was measured in Precisa brand balance under normal atmospheric conditions according to the R0 (15) standard. Under at known pressure normal and bulky nonwoven fabrics were measured by the Mitutoyo thickness device. For determination of tensile strength; The force was applied to the fabric cut in 350x50mm dimensions fixed between the jaws of the tensile tester until rupture occurred (distance between jaws 200 mm, test speed 100 mm / min). In determination of elongation at break; The change caused by the force causing rupture was measured in Zwick / Roell Z0.5 brand device according to ISO 13934-1 standards. In the determination of tensile strength and elongation, 5 fabrics for each experiment were tested according to the machine and cross direction. For the tensile elongation and tensile strength tests of wet fabrics, 1 liter of solution containing non-ionic wetting agent not exceeding 0.05% was kept for at least 2 hours, then tests were carried out. For the drop test; with micropipette, 1 ml of pure water containing 9 g / l NaCl at a distance of 1 cm was repeatedly applied to the fabrics cut to 10 cm *10 cm according to ISO 9073-13: 2001 standards. For the liquid absorption time test, the ratio of the amount of absorbent liquid condition per unit full of the absorbent structure to the dry mass of the structure was determined by calculating according to EDANA 10.3.99 standards. According to ISO EN 9073-6 standard, the cells placed in the cage system for the liquid absorption time are left in 25 mm liquid, and the complete

submergence and time are calculated. For the stability test, the chemical test was kept in the Nuve TK252 coded air conditioning cabinet under certain periods in the incubator, oven and room conditions to determine whether there is any change in the shelf life physical and microbiological criteria. Fabric physical, mechanical liquid absorption, stability, chemical and subjective tests were carried out in Pakten Healthcare Products R&D Center Laboratories. In accordance with the TS EN 1276 Chemical Disinfectants and Antiseptics standard, Escherichia coli ATCC 10536, Pseudomonas aeruginosa ATCC 15442, Enterococcus hirae ATCC 10541, Staphylococcus aureus ATCC 6538 bacteria were incubated at 35 ° C within 24 hours at 100% concentrations. For irritation tests, Dulbecco's Modified Eagle's Medium (DMEM) was applied to the containing tissues after 18 ± 3 hours pre-incubation, 30 µL for liquid test material and 25 mg for solid test material. Tissues were kept in incubation for 60 ± 1 minutes (37 ± ° C, 5 ± 1% CO_2, 90% ± 10% Relative humidity environment) 3 tissues were used for each test material. Support has been obtained from accredited test organizations to determine the antibacterial and irritation properties of wet wipes. Antibacterial efficiency and skin irritation properties have been tested by accredited laboratories. For subjective evaluations, a blind panel test was carried out by giving antibacterial wet wipes at the settlement site of 20 volunteers.

3. Results and Discussion

The average of physical and mechanical tests on raw fabrics in dry and wet forms is given in Table.5. The measurements of the three fabrics with 80% Polyester / 20% Viscose mixture were made in 5 repetitions of the MD (machine direction) and CD (cross direction) result.

Table 5. 80/20 Test Results of Polyester / Viscose Spunlace Fabrics

No	Weight (g/m²)	Thickness (mm)	Elongation at Break [%]				Tensile Strength [N / 5cm]			
			DRY-MD	DRY-CD	WET-MD	WET-CD	DRY-MD	DRY-CD	WET-MD	WET-CD
C	41,2	0,72	28,3	123,2	29,6	122,2	76,28	29,1	80,7	24,8
S1	41,3	0,72	28,4	122,2	29,4	118,1	83,32	26,7	85,3	23,5
S2	40,7	0,75	26,3	124,6	27,9	121,9	85,48	28,9	89,4	27,3

According to the tensile strength test results (Fig.4), it is seen that the MD direction test presented C, S1 and S2 coded fabrics have higher strength values compared to the CD direction. In addition, it is seen that the wet fabric strength values are higher than the dry fabric strength values.

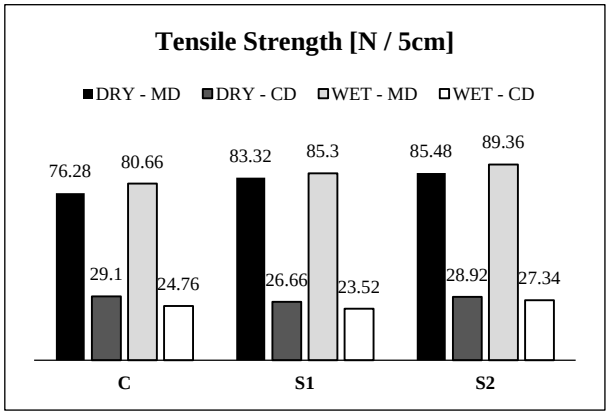


Figure 4. Tensile Strength [N / 5cm]

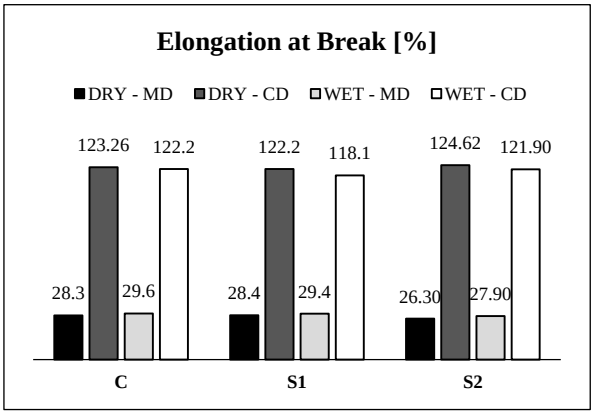


Figure 5. Elongation Strength [N / 5cm]

According to the elongation at break test results (Figure.5), it is seen that the C, S1 and S2 coded fabrics tested in the MD direction have lower elongation values than the CD direction. In addition, it was observed that the wet fabric elongation values were lower than the dry fabric elongation values in three fabrics. It was determined that the dry and wet MD and CD directions of the tested fabrics were inversely proportional to the strength and elongation results. It can be said that the reason for this is that the nonwoven surface change fibres originate parallel to the laying direction.

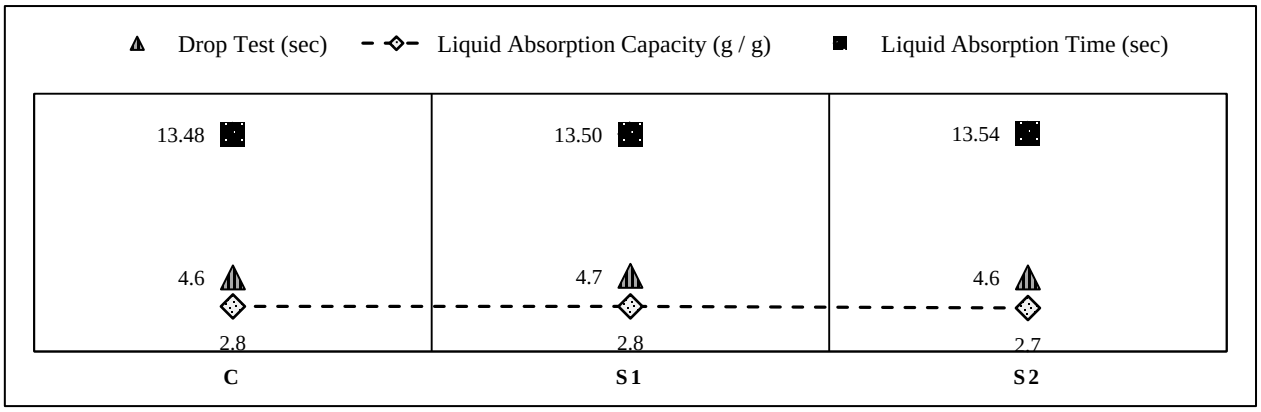


Figure 6. Liquid Absorption Properties Test Results

Test results of liquid absorption properties of raw fabrics are given in Figure 6. Test results of liquid absorption properties of raw fabrics are given in Figure 6. Drop test liquid absorption time and absorption capacity values of C, S1 and S2 coded fabrics show results close to each other. For these tests, in which the liquid properties of wet wipes are determined, it is required to take on the cooling properties and hold for a long time. Therefore, in the water drop test, it can be said that the hydrophilic properties are good as the

fabric samples absorb water in less than 5 seconds. In the literature, it is mentioned that if the polyester content is increased, the liquid absorption time of the fabrics is extended and they do not absorb them at all despite the hydrophilic finishing process [14]. For this reason, in this study, this situation was prevented by mixing polyester fibers with viscose fibers due to their high cellulose content.

Table 6. Shelf Life and Chemical Changes

Shelf Life and Chemical and Physical Properties		C	S1	S2
Before Application	Ph	5	5	5
	Viscosity [cp]	10	10	10
	Density [g/l]	0,988	0,989	0,989
4°C Incubator (3 months)	Ph	5,1	5,3	5,2
	Viscosity [cp]	10,1	10,4	10,6
	Density [g/l]	0,990	0,989	0,991
25°C Room Temperature (3 months)	Ph	5,2	5,2	5,3
	Viscosity [cp]	10,3	10,8	11
	Density [g/l]	0,990	0,990	0,991
40 °C Oven (3 months)	Ph	5,6	5,6	5,6
	Viscosity [cp]	10,5	11	11,2
	Density [g/l]	0,992	0,991	0,992

It is desirable that the wet wipes do not lose pack wetting, depending on the elapsed time. Therefore, to apply an aging test in the oven, room temperature and incubator in 1-2 and 3 months in order to be equivalent to the consumer meeting form. From the produced wet wipes, 65 wipes in 3 packages of 15 * 19 cm ± 1 cm in size were packaged for each experiment and their mouths were sealed so that they would be sealed. It has been determined that not only the wipe properties but also the colour, odor and deformation of the packages are preserved to preserve their shape on the shelf.

Figure 7. Product Images of Shelf-Life Test

Each month passed for aging tests represents the last year in terms of consumer use of the product. In other words, if the sample remains in the aging process for 1 month, the state of the product at the end of 1 year is simulated. 100 µl bacterial suspension was added to 900 µl disinfectant service room. The contact time was determined as 1 minute. At the end of the contact time, 10 µl of the result from the mixture, 990 µl of neutralizer (SCDLP 20 Polysorbate 80) was added into the system and diluted. 100 µl of each dilution was taken and inoculated on a petri dish with a smear plate. Petri dishes were incubated at 36 ° C for 24 hours. At the end of the period, the colonies were counted and expressed in units per milliliter (cfu / ml) per colony.

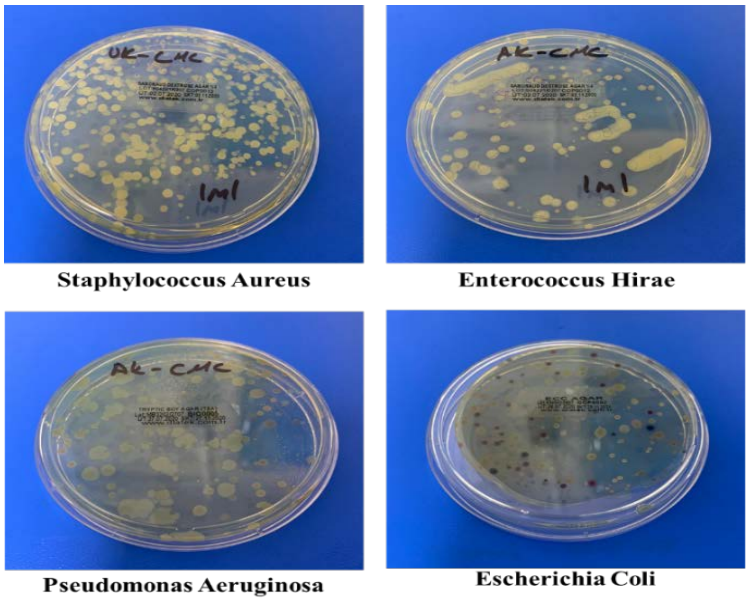


Figure 8. Current (C) Non-Protective Wet Wipes microscope image

Table 7. Bacteria Efficiency Analysis Results

	Bacteria	Staphylococcus Aureus ATCC 6538	Pseudomonas Aeruginosa ATCC 15442	Enterococcus Hirae ATCC 10541	Escherichia Coli ATCC 10536
	Method	TS EN 1276	TS EN 1276	TS EN 1276	TS EN 1276
	N Smear (Kob / ml)	4,4E+08	4,5E+08	3,8E+08	4,4E+08
	Contact Time (minutes)	1	1	1	1
%20 Bleach	First Count (cfu / ml) TCI	3,4E+08	3,4E+08	4,2E+08	3,9E+08
	Log 10 TCI Count	8,5E+00	8,5E+00	8,6E+00	8,6E+00
	Last Count (Kob / ml) TCI	1,0E+00	1,0E+00	1,0E+00	1,0E+00
	Log 10 TCI 2	0,0E+00	0,0E+00	0,0E+00	0,0E+00
	Logarithmic Decrease (cfu / ml) log R	9	9	9	9
	Range	>5	>5	>5	>5
	Activity Level	**99,99**	**99,99**	**99,99**	**99,99**
%70 Ethyl alcohol	First Count (cfu / ml) TCI	3,2E+07	3,1E+07	3,2E+07	3,1E+07
	Log 10 TCI Count	7,5E+0	7,5E+0	7,5E+0	7,5E+0
	Last Count (Kob / ml) TCI	8,0E+00	5,0E+00	5,0E+00	4,0E+00
	Log 10 TCI 2	9,0E-01	7,0E-01	7,0E-01	6,0E-01
	Logarithmic Decrease (cfu / ml) log R	7	7	7	7
	Range	>5	>5	>5	>5
	Activity Level	**99,99**	**99,99**	**99,99**	**99,99**
C	First Count (cfu / ml) TCI	3,2E+07	3,1E+07	3,2E+07	3,1E+07
	Log 10 TCI Count	7,5E+0	7,5E+0	7,5E+0	7,5E+0
	Last Count (Kob / ml) TCI	-	-	-	-
	Log 10 TCI 2	-	-	-	-
	Logarithmic Decrease (cfu / ml) log R	-	-	-	-
	Range	>7	>7	>7	>7
	Activity Level	**0**	**0**	**0**	**0**
S1	First Count (cfu / ml) TCI	3,2E+07	3,1E+07	3,2E+07	3,1E+07
	Log 10 TCI Count	7,5E+0	7,5E+0	7,5E+0	7,5E+0
	Last Count (Kob / ml) TCI	1,0E+00	1,0E+00	1,0E+00	1,0E+00

	Log 10 TCI 2	0,0E+00	0,0E+00	0,0E+00	0,0E+00
	Logarithmic Decrease (cfu / ml) log R	7,5	7,5	7,5	7,5
	Range	>5	>5	>5	>5
	Activity Level	**99,99**	**99,99**	**99,99**	**99,99**
	First Count (cfu / ml) TCI	3,4E+08	3,4E+08	4,2E+08	3,9E+08
	Log 10 TCI Count	8,5E+00	8,5E+00	8,6E+00	8,6E+00
	Last Count (Kob / ml) TCI	1,0E+00	1,0E+00	1,0E+00	1,0E+00
S2	Log 10 TCI 2	0,0E+00	0,0E+00	0,0E+00	0,0E+00
	Logarithmic Decrease (cfu / ml) log R	8,5	8,5	8,6	8,6
	Range	>5	>5	>5	>5
	Activity Level	**99,99**	**99,99**	**99,99**	**99,99**

The disinfectant efficacy of 70% ethyl alcohol from the first minute was observed in its 4 bacterial species. According to Table 7, the logarithmic decrease was the lowest in ethyl alcohol. Optimum bactericidal agents are 60-90%. Due to the rapid effect of ethyl alcohol, it is known that it has a permanent effect on bacteria. Therefore, by adding additional substances to alcohols, it can be provided much stronger and longer. Alcohol is prevented from contact with organic substances, which are in the content of penetration weaknesses. Therefore, the effectiveness of alcohols should be in clean conditions [15]. Hypochlorite is a widely used disinfectant. It is cheap and fast-acting, but has disadvantages such as etching metals and being inactivated by organic matter [16]. In the 1st and 15th minutes, the most effective agent with the highest logarithmic decrease was hypochlorite with 20%. It was determined by this study that 99.99% of S1 (0.11% benzalkonium chloride) and S2 (0.20% benzalkonium chloride) monitors are disinfectant after the first minute. Following 1 contact with the test product, less than 7 logarithmic microbes were obtained versus all bacteria.

Table 8. Wet Wipes Skin Activity Analysis Results

Sample	Code	Average OD	Average OS	Viability Average (%)	% SS	CV (%)
	NC	1,658	0,023	100	1,39	1,39
S2	PC	0,201	0,026	12,1	1,55	12,74
	TM	1,386	0,029	83,6	1,74	2,08

According to EU and GHs (Global Harmonized system) classification, if the relative tissue viability of 3 separate tissues exposed to the test material is less than 50% (compared to negative control), the test material is

considered irritant. According to the results of the tests carried out in accordance with the OECD TG 439 test standard, it was determined that the average viability rate of the test material was 83.6% and this rate did not have an irritating effect on the skin.

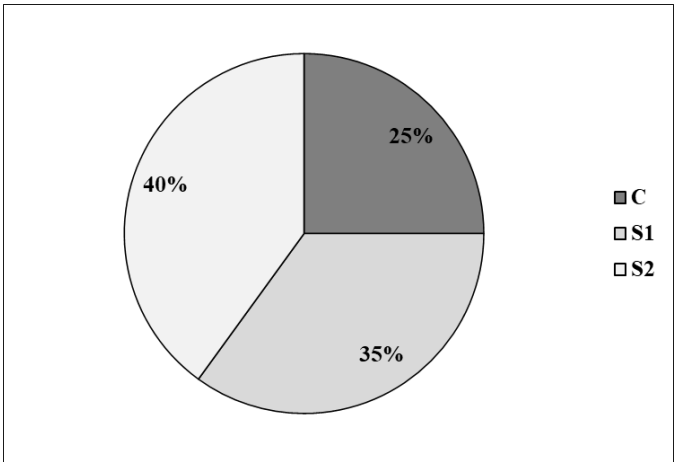


Figure 5. Consumer Overall Assessment

A general evaluation was made for 20 consumers regarding the questions such as comfort of usage, odor, cleanliness, and the adequacy of wetness in consumer panel tests. Five consumer preferred C wet wipes, seven consumers preferred S1 wet wipes and eight consumers preferred S2 wet wipes.

4. Conclusion

Scientists say that washing hands with water and soap for an appropriate time (15 seconds) significantly reduces the temporary flora infections at a low rate in the hospital. Antiseptics are more suitable for the section where the risk of infection is higher than the temporary flora in the section to disappear from the environment. There is a study on the use of various cleaning and antiseptic agents in cleaning or disinfecting hands. In the studies, in applications where different results occur depending on the application amount of the cleaning and antiseptic agents used. The bacterial activity of wet wipes used with different calculations (0.11 and 0.20) of benzalkonium chloride, which is known to be effective against these antiseptic agents, was investigated. In the study, in physical, mechanical liquid absorption, stability and chemical tests, results close to the existing wet wipe fabric (C) of S1 and S2 monitoring were determined on the wet wipe fabric with 80% polyester 20% viscose content. The purpose of conducting these tests is only because there are fabrics that have the same time as the existing fabric so that the service provider difference can be observed. 70% ethyl alcohol, 20% hypochlorite, S1 and S2 coded wet wipes shows an effective Antibacterial activity according to TS EN 1276

standards. In this standard, the test sample have eliminated Escherichia coli ATCC 10536, Pseudomonas aeruginosa ATCC 15442, Enterococcus hirae ATCC 10541, Staphylococcus aureus ATCC 6538 99.9% bacteria in 1 minute. According to this study, it was seen that wet wipes without antiseptic alone are sufficient in providing hand hygiene. Antibacterial wipes that are not washed with water and soap can be an alternative. In this respect, it has been determined that antibacterial wet wipes are not harmful to the skin by examining skin irritation in line with the OECD TG 439 test standard. As a result, the importance of production and pre-marketing studies for the products that are planned to be put on the market as a result of chemical and microbiological analyzes made with the use of disinfectant substances in the right concentrations and in sufficient time has observed in this study.

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