DEVELOPMENT AND ANALYSIS OF THE HAND ALCOHOL DISINFECTANT

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Abstract

Food cannot be exposed to the danger of pollution in its circulation. Hand hygiene is one of the simplest and most effective methods of preventing food poisoning by microbes. One of the most important parts of hygiene consideration is the hygiene of staff, including hand washing and disinfestations. It is connected with the right choice of disinfectant, actualizing the necessity to use low risk biocides which are completely biodegradable. Low risk biocide can't contain active substance which is bioacumulative, hardly degradable or classified as carcinogenic, mutagen and toxic to reproductive system or allergic. Low risk biocide is safe for environment and non-toxic to people. Ethanol is mentioned in the laws and legislations of the European Union as an active substance in the low risks biocides. According to European Union Biocide Directive (16.02.1998.) 98/8/EK alcohol hand disinfectants belongs to the first group of biocide as biocide for peoples hygiene. That is why a new formulation of a hand disinfectant on the base of ethanol has been made where besides the active substance, hand moisturizers and emollients are included. They help to keep the hand skin healthy, preventing its irritation. Alcohol hand disinfectant is a clear colorless gel, pH can vary from 7.0 to 7.7, the content of ethanol in mass is from 62% to 64%. It is important to ensure the bactericide and fungicide influence of the disinfectant. That is approved during research, according to LVS EN 1040:2006 (11.04.2006) and LVS EN 1275:2006(11.04.2006), use test microorganisms *Staphylococcus aureus* ATCC 6538, *Pseudomonas aeruginosa* ATCC 15442, *Salmonella typhimurium* ATCC 14028, *Candida albicans* ATCC 10231, *Aspergillus niger* ATCC 16404. A technology of manufacturing is made to secure the industrial produce of the disinfectant. A technical documentation for this disinfectant is made during this research, which includes the information required for the user of this product. Documentation includes the safety data sheet for this product, which informs about danger identification, specification, which presents information about the product stock qualities, product describing parameters, its terms of transportation and storage, its warranty period and technical task with information about the text on product label.

Key words: skin hygiene, hand disinfectant, microorganisms

Introduction

Skin hygiene, particularly of hands, is considered to be one of the primary mechanisms to reduce risk of transmission of infectious agents by both the contact and fecal- oral routes.

But depending on the product used, washing can raise the pH of the skin. Long-term changes in skin pH can cause skin damage, increased skin shedding, since some of the antibacterial characteristics of the skin are associated with its normally acidic pH (approximately 6.0). With prolonged soap contact, skin pH can reach 7.0–8.5 and remain high for 3–4 h. Soaps and detergents, particularly those that are anionic or cationic, are the most damaging of all substances routinely applied to skin (Larson, 1999)

Besides washing defeats the skin and the rate of lipid replenishment on the dorsum of the hands is only 20% after 1 h and 50% after 3 h. But fatty acids also have fungicidal and bactericidal activity important in modulating the skin flora (Larson, 1999)

It is important to recall that hand disinfection is significantly more efficient than standard hand washing with soap and water.

According to the field of application, strategies for the prevention of the transfer of microbial skin flora from the hands must consider the various categories of flora: transient, resident or infection flora. In contrast, resident skin flora is usually regarded as pathogenic only under certain circumstances such as in surgery. In the non-surgical field, only the transient and infection flora from the hands play a role (Pittet, 2001). Hands already contaminated may be rendered safe by procedures for the elimination of transients such as hand washing, hygienic hand wash.

Among all usable chemicals, ethanol, isopropanol and n-propanol (in the order of increasing efficacy) are the strongest and fasten agents. Most common used concentrations are: ethanol (60–90%), isopropanol (70–80%) and n-propanol (60–70%).The duration of treatment (between 30 and 60 s) significantly influences the achievable reduction of microbial release.

There exists a strong positive correlation of the reduction of microbial release and the hand treatment, between 1 to 5 min.
Alcohol preparations gives excellent spreading quality and rapid evaporation Alcoholic preparations are at least as tolerable for the skin as antiseptic detergents if they contain suitable emollients (Hygiene-Institute, 2001)
Other most popular active ingredients in hand disinfectants are: povidone-iodine, chlorhexidine gluconate and triclosan. But all of them are some specific negative properties compare to alcohol hand disinfectants.
The essential importance is antimicrobial efficacy of hand disinfectants witch are regulate by European Norms. A suspension test for the demonstration of bactericidal activity (EN 1040) is obligatory for hand disinfectants in all fields of application, but test to prove activity against yeasts applies only to hygienic hand rub (Division of Hygiene, 2006)
The purpose of work is to create the new hand disinfectant based on ethanol which is safe for environment.
Tasks:

1. To create prescription of alcohol hand disinfectant
2. To create manufacture technology of alcohol hand disinfectant
3. To define physical and chemical properties of alcohol hand disinfectant
4. To evaluate alcohol hand disinfectant – concentrate activity on test microorganisms: *Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella thyphimurium, Candida albicans, Aspergillus niger*
5. To create a technical documentation of alcohol hand disinfectant

Materials and Methods
Characterize of raw materials included in alcohol hand disinfectant:
Monopropylenglycol. It is widely used in cosmetics and toiletries. Its emollient, solvent and non-toxic qualities are very important.
Glycerine. It serves as an excellent emollient, moisturizer and lubricant to prevent skin dryness in personal care products.
Neo-PCL. Consist of a mixture of fatty acid polyglycol ether and fatty alcohol polyglycol ether. As re-fatting and over-fatting agent, it makes skin soft, smooth and elastic. It is moisturizer and emollient. This ingredient regulates lipid balance in skin.
Acrylate polymer. It is used as thickening agent of hydroalcoholic hand disinfectants systems. Provides excellent skin feeling, isn't sticky and has very high clarity in the hydroalcoholic systems.
Trietanolamin. It is used as neutralizing agent.
Deionized water. Deionized water is specially prepared of drinking water in EUROWATER equipment. It is important because di-and multi-valent ions (like calcium and magnesium) will precipitate polymers. Using of deionized water essential influences clarity and viscosity of ready product (Table 1).
Perfume. **(***Citrone*)
Alcohol. It is used as active antimicrobial ingredient in appropriate concentration.
Bactericidal and fungicidal activity is tested according standards:

1. LVS EN 1040:2006 (11.04.2006.) „Chemical disinfectants and antiseptics – Quantitative suspension test for evaluation of basic bactericidal activity of chemical disinfectants and antiseptic – Test method and requirements.
2. LVS EN 1275:2006 (11.04.2006.) „Chemical disinfectants and antiseptics – Quantitative suspension test for evaluation of basic fungicidal or basic yeasticidal activity of chemical disinfectants and antiseptic – Test method and requirements.

Recommendation „Control of efficacy of disinfection in medical institutions", 1988.

Acording with standards alcohol hand disinfectant – concentrate is tested on test microorganisms:

1. *Staphylococcus aureus* ATCC 6538
2. *Pseudomonas aeruginosa* ATCC 15442.
3. *Aspergillus niger* ATCC 16404
4. *Candida albicans* ATCC 10231
5. *Salmonella typhimurium* ATCC 14028

Results and Discussion

As result prescription of alcohol hand disinfectant was made. It includes all raw materials in balanced concentrations. Concentration of active ingredient – alcohol is 62%.

A technology of manufacturing is made to secure the industrial produce of the disinfectant. To make alcohol hand disinfectant raw materials are put in reactor in following order:

Deionised water→ Acrylate polymer →Aroma →Alcohol → Neo-PCL → Glycerin → Monopropylenglycol → Trietanolamin.

After mixture of all ingredients as result is clear, transparent gel with small bubbles in mass (Table 2).

Table 1

Physical and chemical properties of water

Parameters	Water		
	Drinking water	**Specially prepared water in EUROWATER equipment 2nd level**	**Deionised water in EUROWATER equipment 3rd level**
Conductivity, µS cm^{-1} (25 °C)	615±1	612±1	5.9± 0.1
pH (20 °C)	7.32±0.01	7.5±0.01	5.66±0.01
Hardness, mmol l^{-1}	3.0±0.02	0.3±0.01	0.1±0.01
Fe^{2+} + Fe^{3-}, mg l^{-1}	1.06±0.1	0.05±0.1	0.03±0.1
Ca^{2+}, mg · l^{-1}	35±1	1	–
Cl^-, mg l^{-1}	12±1	12±1	–
SO_4^{2-}, mg l^{-1}	30±1	17±1	–
Turbidity, NTU	9.78±1	0.1	0.1

Table 2

Physical and chemical properties of Alcohol hand disinfectant

No.	Name	Parameters
1.	Appearance	Clear, transparent gel
2.	Colour	Colourless
3.	pH	7.0– 7.7
4.	Content of ethanol in mass %	62.0–64.0

According to results using this disinfectant in following concentrations 3 g and 7 g with exposure times 30 s and 1 min disinfectant can be declared as having a bactericidal effect on *Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella thyphimurium,* and a fungicidal effect on *Candida albicans.* But it isn't effective against microorganism spore

according to research on *Aspergillus niger*. Alcohol gel shows only fungistatic effect on moulds (Table 3).

Table 3

Microbiological testing results of Alcohol hand disinfectant

Microorganisms suspension	Concentrate 3 g, 30 s	Concentrate 3 g, 60 s	Concentrate 7 g, 30 s	Concentrate 7 g, 60 s
Staphylococcus aureus **ATCC 6538**	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation
Pseudomonas aeruginosa **ATCC 15442**	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation
Aspergillus niger **ATCC 16404**	Positive after 48 h incubation	Positive after 48 h incubation	Positive after 48 h incubation	Positive after 48 h incubation
Candida albicans **ATCC 10231**	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation
Salmonella typhimurium **ATCC 14028**	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation	Negative after 5 days incubation

A technical documentation for this disinfectant is made during this research, which includes the information required for the user of this product.
Documentation includes the safety data sheet for this product, which informs about danger identification. Specification, which presents information about the product stock qualities, product describing parameters, its terms of transportation and storage, its warranty period and Technical task with information about the text on product label.
Product specification declares, that: Alcohol hand disinfectant contains skin softening and moistening substances. The cure creates pleasant refreshment feeling. It is meant for use in medical institutions, food turnover enterprises, and other public institutions. Biocide meant for humans hygiene. It does not constitute every day washing of hands. Inventory number of biocide is 19022007/1722.

Conclusions

Alcohol hand disinfectant is:

1. Fast-acting bactericidal and fungicidal agent with optimal anti-microbial spectrum
2. Low risk biocide which is safe for environment and non-toxic to people. Completely biodegradable.
3. Alcohols with the addition of appropriate emollients and moisturizers are less irritant on skin than any antiseptic or non-antiseptic detergents.
4. During complex hand hygiene providing procedure isn't possible biocide active substances neutralization by anionic surfactants.
5. It requires less time to put preparation on hands which is really important in status with high intensity of work
6. Alcohol hand disinfectant provides excellent hand care in conditions when water sources aren't available.

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