RESEARCH ON PREPARATION AND INITIAL ASSESSMENT OF THE WATER DISINFECTANT EFFECT OF SKN TABLETS USED FOR SOLDIERS IN TRAINING AND COMBAT READINESS

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Abstract

Objectives: *Develop a preparation process and initially evaluate the antiseptic effect on tap water and river and lake water of SKN tablets used for soldiers in training and combat readiness.* ***Methods:*** *Research on the preparation and development of basic standards for SKN tablets containing 3.5 mg of sodium dichloroisocyanurate (NaDCC); Initial evaluation of the water disinfection effect (E. coli, coliform) on tap water and river and lake water of SKN tablets.* ***Results:*** *Evaluated and selected the formula for preparing SKN tablets including NaDCC 3.5 mg, Sodium starch glyconate 19.2 mg, Sodium carbonate 64 mg, Mannitol 218.9 mg, Talc 9.6 mg, Magnesium stearate 3, 2 mg, Aerosil 1.6 mg; SKN tablets have the effect of killing E. coli and coliform bacteria on 3 water samples (tap water, river water and lake water).* ***Conclusion:*** *The preparation process has been developed and initially evaluated the water disinfection effect of SKN tablets.*

Keywords: *SKN tablets, water disinfection effect.*

I. INTRODUCE

In training and combat readiness, complete logistical preparations such as: food, drinks, military uniforms,… is always necessary. In a war, weapons and foods can be packed and carried. But, most of using water must be garthered from the local resources. These are untreated water sources so it may cause many diseases for the user such as dermatological diseases (itchy rash, pimples, foot fungus, foot ulcers, scabies…), Intestinal and digestive diseases (diarrhea, cholera, typhoid), Eye diseases, …[1].

Water purification tablets or water disinfection tablets is one way to treat water for human domestic water during field operations when there is no way to access treated water. These tablets effectively kill microorganisms in water to prevent most diseases caused by polluted water. Currently, water purification tablets are widely used in the military because they are a convenient and practical solution that can solve the

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problem of purifying drinking water on the spot quickly and safely [2].

In our army, it is really necessary to research and produce water disinfectant tablets to equip soldiers. So that, we conducted research to develop a process for preparing SKN tablets and initially evaluated the water disinfectant effect based on its ability to kill *E. coli* and coliform in water. Therefore, it is possible to create a water disinfectant tablet product used in training and combat readiness of soldiers.

II. MATERIALS, EQUIPMENT AND RESEARCH METHODS

2.1. Materials and equipment

Sodium dichloroisocyanurate (NaDCC) standard substance 96.0% content, excipients (wheat starch, sodium starch glycolate, sodium carbonate, avicel, talc powder, magnesium stearate, aerosil,… according to Manufacturer's standards), KI, concentrated H_2SO_4 solution, 0.1N $Na_2S_2O_3$ (standard tube), starch paste,…

Equipment: 250ml Erlenmeyer flask, assorted beakers, 25ml burettes, assorted volumetric flasks, assorted pipettes, Metler Toledo analytical balance with sensitivity of 0.1mg, Erweka cube powder mixing equipment, 9mm mortar diameter tablet press, dryer…

2.2. Research menthods

2.2.1. Research on the preparation of SKN tablets

2.2.1.1. Developing the formulation of SKN tablets

- Survey and selection of excipient types and ratios

- Survey other factors (if necessary): disintegrating excipients, fillers,... tablet compression force, stabilizers...

2.2.1.2. Developing the SKN tablet manufacturing process

Prepare 3 batches, each batch of 100 tablets according to the above expected procedure. Test the quality indicators, evaluate the efficiency and stability of the process to draw conclusions. If the preparation process does not meet the requirements, perform the wet granulation method with adhesive excipient PVP alcohol or use commercially available straight stamping excipients.

2.2.1.3. Evaluation of quality indicators of SKN tablets

According to the quality criteria in DĐVN V [3]

Properties: white tablets, chlorine smell, intact walls and edges.

Mass uniformity: ± 5% KLTB tablet.

Disintegration speed: Disintegration speed should not exceed 3 minutes.

Qualitative: has the characteristic reaction of chlorine.

Quantitation: The sodium dichloroisocyanurate content in each tablet must be from 70.0 - 130.0% of the amount stated on the label,

calculated according to the average tablet weight.

2.2.2. Initial assessment of the water disinfection effect of SKN tablets

2.2.2.1. Evaluate the ability to kill E. coli by direct culture method

- Weigh 10g of the preparation, mix with 90 ml of pH 7.2 buffer solution to obtain a solution with a dilution of 10^{-1}, continue to dilute to a solution with a dilution of 10^{-2}, 10^{-3}.

- Add to each petri dish 50 µl of E.coli ATCC 8739 strain at a concentration of 10^3 and 01 ml of the preparation solution with dilutions of 10^{-1}; 10^{-2}; 10^{-3}; 10^{-4}, then add 20 ml of MacConkey agar medium to each petri dish, incubate at 35^{o}C for 72 hours.

- Control plate: Proceed in parallel as above, but do not put the preparation in the petri dish.

2.2.2.2. Evaluate the ability to kill E. coli using the agar plate perforation method

Add 1 ml of *E. coli* strain suspension with concentration of 10^5, add 20 ml of MacConkey agar, mix well, let cool. After punching the agar holes, put into each agar hole 100 µl of the test solution with dilutions of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}. Leave for about 1 hour, then incubate at 35^{o}C for about 24 hours.

2.2.2.3. Evaluation of coliform killing ability by agar plate punching method

Proceed by perforating agar plates as a method to determine the ability to kill E. Coli, only replacing MacConkey with Violet agar medium, incubating at 35^{o}C for 24 hours.

2.2.2.4. Initial evaluation of the water antiseptic effect of SKN tablets

Take different water samples (tap water, river, stream, lake - must be transparent water), 3 samples of each type, put each types into 1000 ml glass bottles, seal immediately. One bottle is left intact, one bottle has 1 research tablet to, add 1 control effervescent tablet with active ingredient NaDCC 3.5mg to the other bottle, close the lid, and let it stabilize for 30 minutes. Conduct parallel testing of microbiological criteria according to TCVN 6187 - 1: 2009 method, synthesize and evaluate the results (*E.coli, Coliform*).

III. RESULT

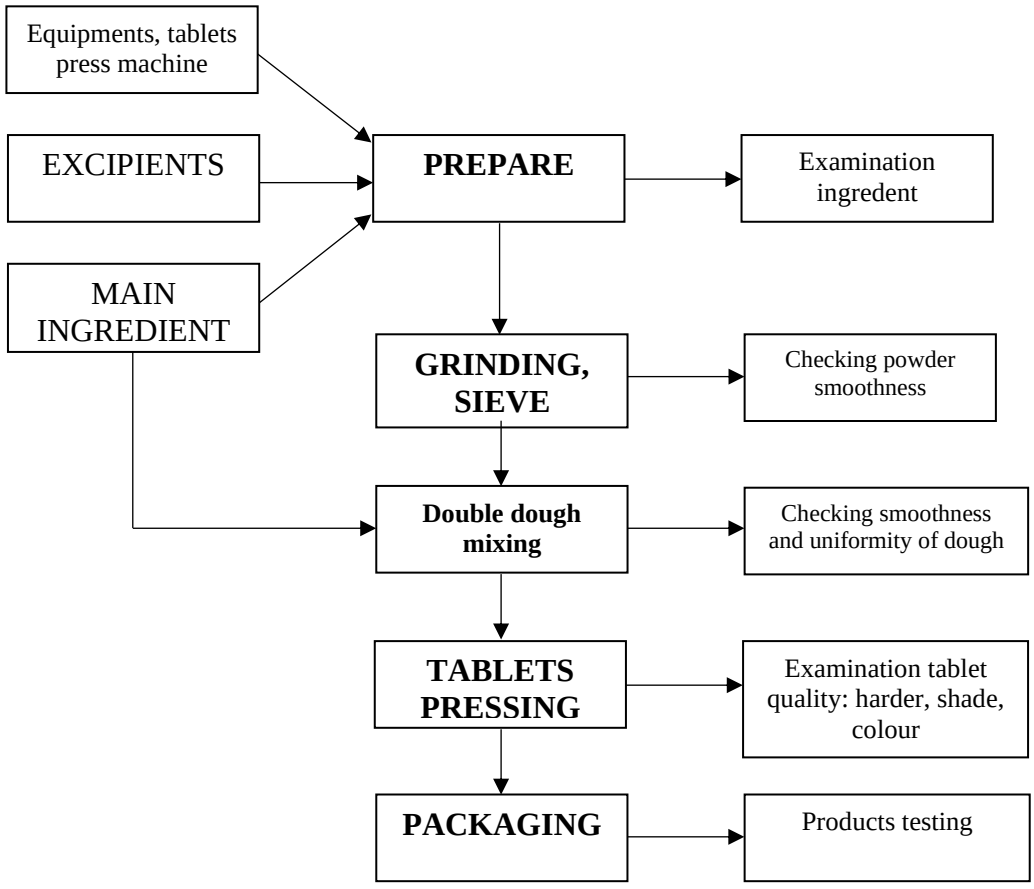
3.1. Results of research on SKN tablet preparation formula

Following the results of the survey and selection of disintegrant excipients, filler excipients, disintegration, pH, and quantification, we chose the following formulation for SKN tablets.

- NaDCC 3.5 mg
- Natri starch glyconat: 19.2 mg
- Natri carbonat: 64 mg
- Manitol: 238.9 mg
- Talc: 9.6 mg
- Magnesi stearat: 3.2 mg.
- Aerosil: 1.6 mg.

Tablet weight 340 mg, tablet diameter 9 mm

3.2. Results of developing SKN tablet preparation process



Hình 1. Sơ đồ quy trình bào chế Preparation process diagram

Process description:

Step 1: Prepare

- All main ingredients and excipients were dried at 110°C for 30 minutes and cooled in a desiccator.

- Clean and sterilize the production area to meet the requirements of the production preparation room and meet product manufacturing standards.

- Tools, equipments and other accessories used in preparation meet prescribed standards.

Step 2: Grinding and sieve

- Finely grind each type of excipient and main ingredients.

- Sieve through 180 µm sieve

- Control the smoothness and moisture content of excipients and main ingredientss.

Step 3: Double mixing, excipients combination

- Weigh the main ingredient powder together with Natri carbonat excipient. (In living environment, ingredient easy to get wet. It cause mistake in weighing and hard to

grinding). After grinding, mix all powder follow the recipe and double dough mixing principle.

- Powder is mixed by Kalweka cubic powder mixer. Examination the smoothness and uniformity of powder.

Step 4: Table press

- Maintain humidity of table press room around ≤ 70ºC; room temperature from 24 to 26ºC. Tablets are pressed by single punch press machine. Each tablets have 320mg weight and 9mm diameter with suitable harder.

- Examination tablets include weight, harder, colour. Tablets are not meet requiremnets will be out.

Step 5: Packaging and Completing

- After pressed, tablets will be dried at 80ºC for 30 minutes, cool in a desiccator for 24 - 48 hours. It makes tablets become stable and ready to finished product testing.

- Tablets will be packaged in sealed jar include desiccant or blister pack to isolated from the environment.

3.3. Results of evaluating SKN tablet quality criteria

Making 3 batchs, each batch have 100 tablets follow recipe and manufacturing process, tested according to the criteria in the proposed base standard. The result is showing at table 1

Table 1. Results of evaluating SKN tablet quality criteria

TT	REQUIRE	RESULT		
		Batch 1	**Batch 2**	**Batch 3**
1	**Properties: White tablets**	Pass	Pass	Pass
2	**Weight uniformity:** ± 5%	Pass	Pass	Pass
3	**Qualitative**	Pass	Pass	Pass
4	**Disintegration:** Disintegration rate ≤ 3 minutes	Pass	Pass	Pass
5	**Quantitative:** The Sodium dichloroisocyanurate content in each tablet must be 70.0 - 130.0% of the amount stated on the label, calculated on the average tablet weight.	Pass (93.17%)	Pass (93.17%)	Pass (93.17%)

Comment: The preparation process on a scale of 100 tablets/batch is stable, easy to perform, and suitable for laboratory conditions. The pellets produced meet the quality criteria according to DĐVN V.

3.4. Initial Results of evaluating the water disinfection effect of SKN tablets

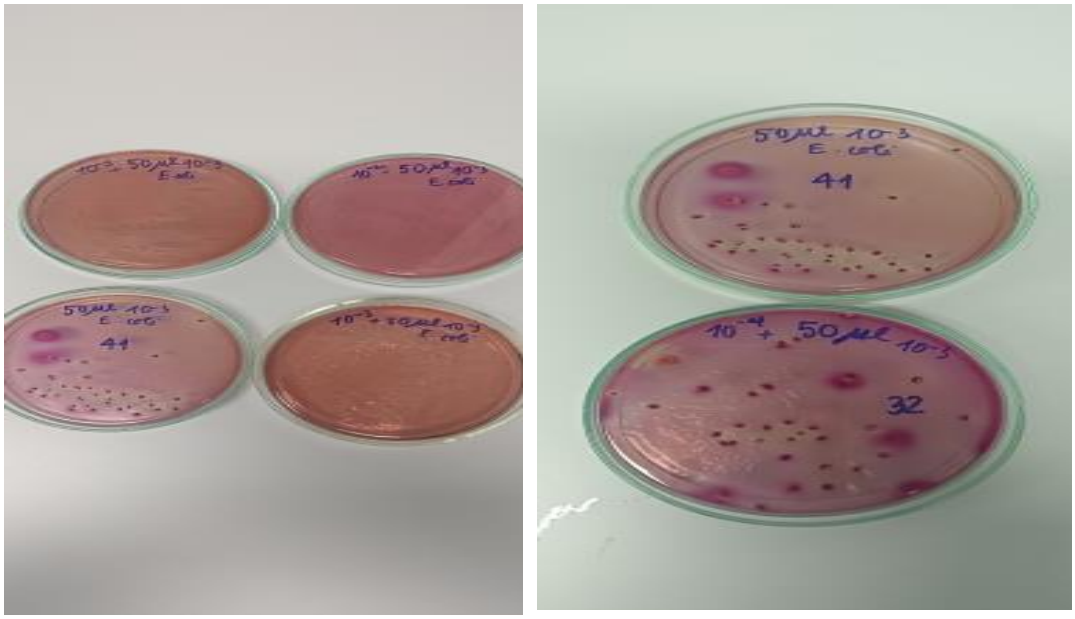
3.4.1. Evaluation of E. coli killing ability by direct culture method

Results showed that:

+ On the positive control plate: There were 41 CFU *E. coli* growing on the agar plate.

+ On plates inoculated with 50 CFU of *E.coli* strain and preparations with dilutions of 10^{-1}, 10^{-2}, 10^{-3}: there is no *E. coli* grew on the agar plate.

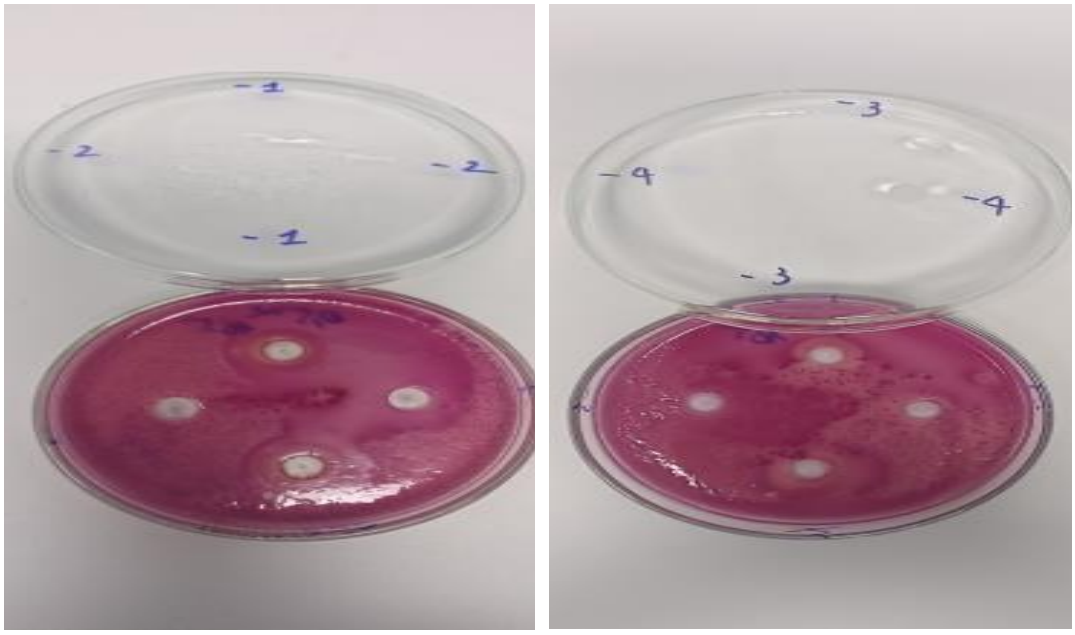
+ On the plate inoculated with 50 CFU of *E.coli* strain and the preparation with dilution of 10^{-4}: there are only 32 CFU *E. coli* grew on the agar plate (9 CFU *E. coli* disinfected).



Picture 2. Evaluation of *E. coli* killing ability by direct culture method

3.4.2. E.coli killing ability by agar plate punching method

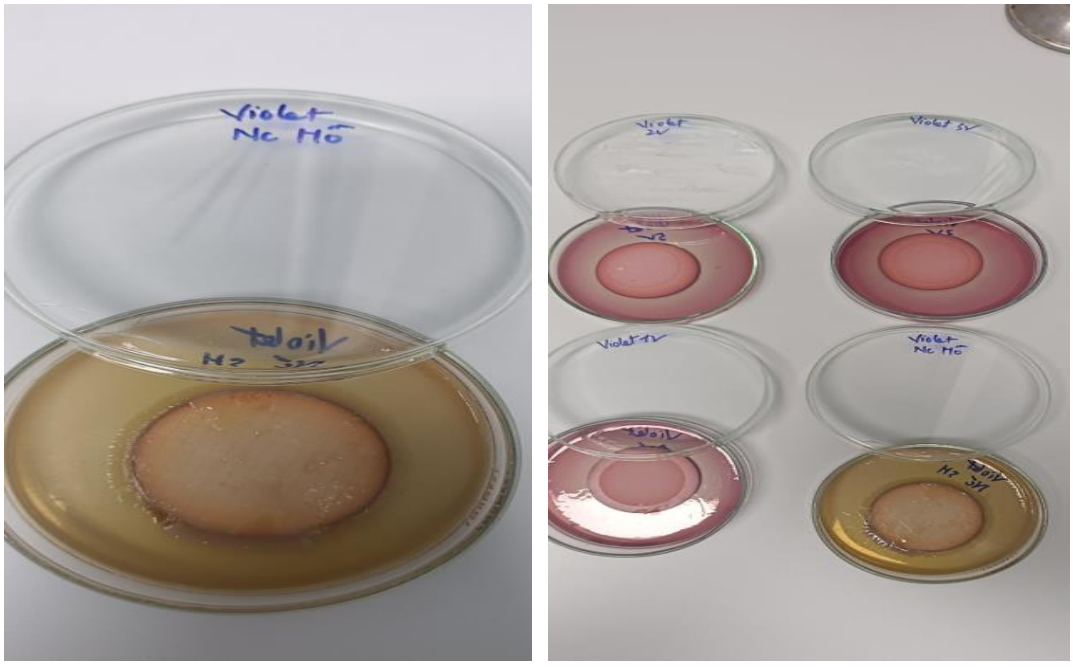
The results showed that all 4 dilutions tested showed a sterile ring as shown in the image below:



Picture 3. Evaluation of *E.coli* killing ability by agar plate punching method

3.4.3. Coliform killing ability

Results showed that: On the agar plates: water samples add 1 tablet, 2 tablets, 3 disinfectant tablets in 1 liter of water, no coliform appeared.



Picture 4. Evaluation of Coliform killing ability

3.4.4. Initial evaluation of the water disinfection effect of SKN tablets

The Results showed in Table 2:

Table 2. Results of evaluating the water disinfection effect of SKN tablets

STT	Water type	Sample code	E.coli	Coliform
1	Tap water	DV86, PV362, PV305	Fail	Fail
		DV86*, PV362*, PV305*	Pass	Pass
2	River water	NA, DV82. DV83	Fail	Fail
		NA*, DV82*. DV83*	Pass	Pass
3	Lake water	HD1718, DV94, AT	Fail	Fail
		HD1718*, DV94*, AT*	Pass	Pass

From the above results, we found that when adding water disinfectant tablets to infected water, it gave good disinfection results on both 3 samples (Tap water, river water, lake water) - Samples code DV86*, PV362*, PV305* NA*, DV82*, DV83* HD1718*, DV94*, AT* all met the requirement of disinfectant *E.coli* and Coliform.

IV. DISCUSSION

NaDCC is an active ingredient that releases active chlorine when dissolved in water. By that, it has antiseptic effects. Therefore, during the preparation process, we must be careful to avoid exposing NaDCC to moisture and water. Therefore, the tablet needs a large enough amount of excipients to protect the main ingredient from moisture and the direct compression method is the most suitable choise. With the mass of NaDCC being 3.5 mg, the tablet weight can be selected in the range of 200 mg (can be changed during the experiment, but the ratio of excipients is kept the same), the tablet pressing force is fixed so that the tablet breaking force is in the range of 5 - 8 kP [4], [5].

To limit moisture's effect on the main ingredient, we can use absorbent (hygroscopic) excipients. In the formula, select Sodium carbonate 40mg, accounting for 20% of the formula.

When added the tablet into 1 liter of water, the tablet needs to quickly release the main ingredient to exert its antibacterial effect, so it

is necessary to survey and select the disintegrant (super disintegrant) with the appropriate ratio to achieve the requirements. According to the preparation textbook and instructions for use: Starches at a rate of 5 - 20% of the formula; or modified starches at a ratio of 2 - 6% [6]. Thus, we chose to investigate two types of disintegrants: Wheat starch (Amidon) with 3 levels of CT ratio: 10, 15, 20%; and Sodium starch glyconate (modified starch) with 3 ratio levels in CT: 2, 4, 6%.

The filler excipient in CT uses Avicel, Avicel itself also acts as an adhesive excipient in the straight stamping method. The volume used is just enough for the pellet weight [6].

The selected smooth and glossy excipients are Aerosil 1 mg, accounting for 0.5% of the tablet weight (preparation manual 0.1-0.5%) and magnesium stearate 2 mg, accounting for 1% of the total tablet weight (preparation textbook, instructions for use 1-2%) [6].

Use Talc 6 mg, accounting for a total of 3% of the tablet weight (the preparation textbook instructs to use 2-3%) as a smoothing excipient for the tablet pressing process, often combined with magnesium stearate to add shine for tablet, and to prevent sticking to the mortar and pestle [6].

V. CONCULSION

The preparation process has been developed and initially evaluated the water disinfection effect of SKN tablets.

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