



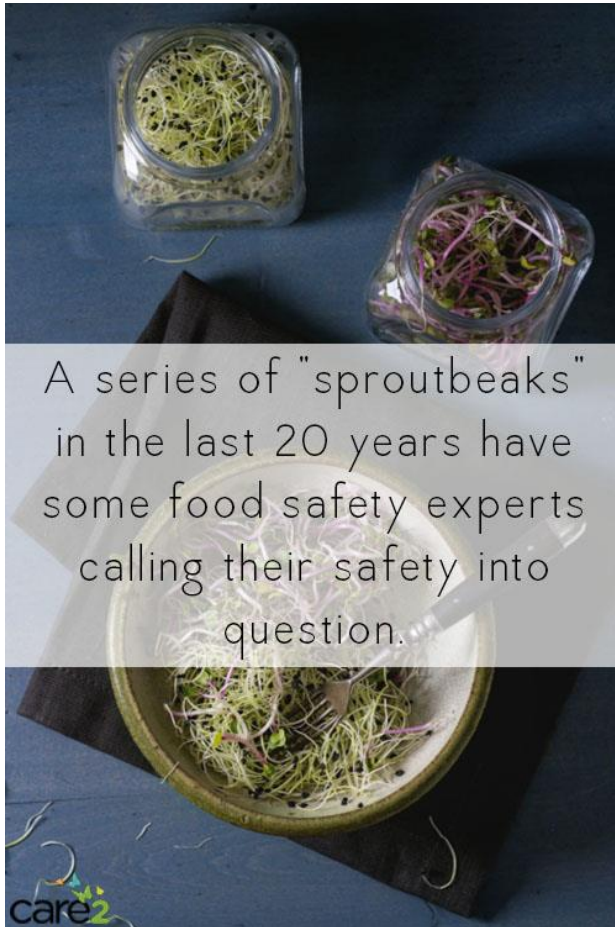
The effect of ionized water on germination, sprouting vigour and microbial contamination of wheat sprouts

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Intro



- Interest in sprouts as a superfood is growing rapidly due to their palatability and nutritional properties.
- The potential microbiological risks are challenging producers in finding innovative ways to ensure product's safety while keeping quality high.
- One of the ways to achieve this is to employ ionized water in sprout production process.

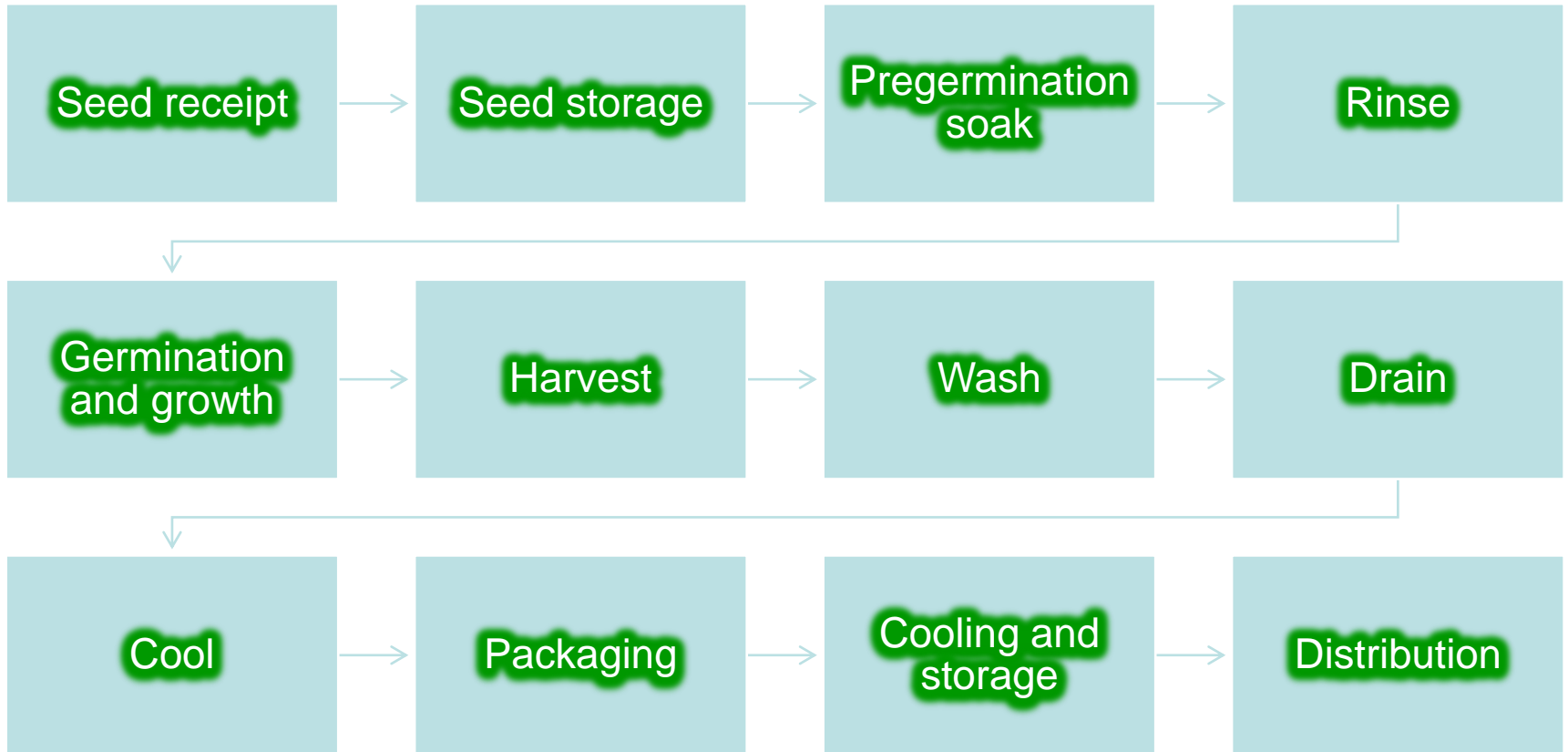


The problem

- Fresh produce is an important part of a healthy diet. However, it is susceptible to contamination.
- Produce is often consumed raw, or only lightly cooked, which may allow pathogens to survive and cause illness.
- Sprouts are especially problematic because the conditions that encourage seeds to sprout are also ideal for growth of pathogens, if present.
- The steps of sprout production do not include processes to eliminate pathogens.



Typical sprout production process





Sprout-associated outbreaks

1996 - 2010:

- 35 sprout-associated outbreaks in USA,
- over 2000 laboratory-confirmed illnesses,
- 123 hospitalizations and 1 death.

Pathogens of concern in sprout-associated outbreaks:

- ***Salmonella* spp.,**
- ***Escherichia coli* O157:H7** and ***E. coli* O157 NM.**



The search for the measures to assure sprouts safety: USA

- 14-12-2012. Members of the **Sprout Safety Alliance** (SSA) gathered to discuss a chapter titled 'Sprout Safety Hazards'.
- This chapter, to be used as part of a sprout safety training program, provides **an overview of different types of food safety hazards and the importance of their control, with emphasis on food safety hazards that have a history of having been associated with sprouts and are considered 'reasonably likely to occur' if not subject to appropriate controls.**



Reducing Microbial Food Safety Hazards for Sprouted Seeds' (the Sprout Guide)

- seed for sprouting be produced using Good Agricultural Practices (GAPs);
- seed handling and conditioning be conducted in a manner that minimizes the likelihood of contamination;
- sprouters employ good sanitation as a standard operating procedure;
- sprouters **treat the seed to reduce pathogens immediately before sprouting**;
- sprouters conduct microbial testing of spent irrigation water (SIW) from every production lot as early as 48 hours into the sprout process to ensure that contaminated product does not enter commerce.



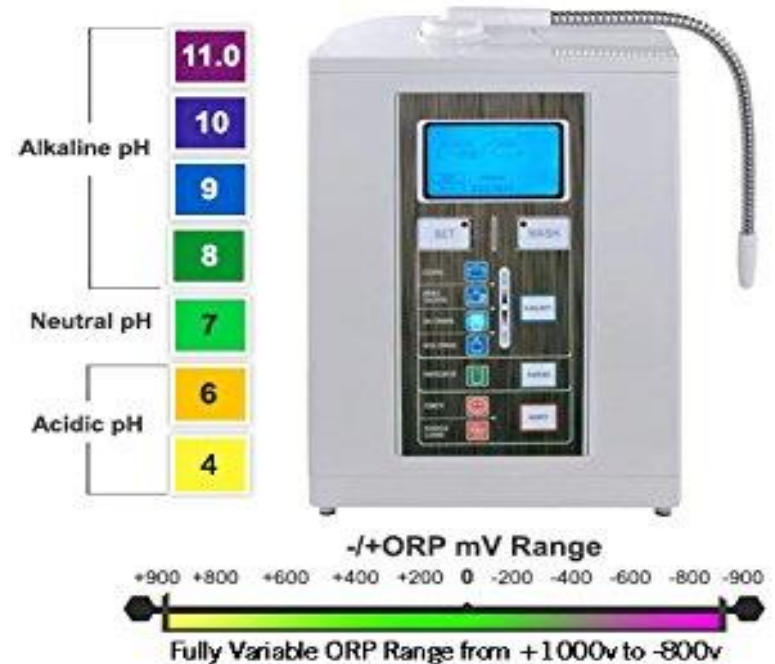
The search for the measures to assure sprouts safety: EU

- A novel strain of **Escherichia coli O104:H4** present in organic fenugreek sprouts: a serious outbreak of foodborne illness focused in
- Germany in 2011. In all, 3,950 people were affected and 53 died.
- European Food Safety Authority (EFSA). **Scientific Opinion on the risk posed by Shiga toxin-producing Escherichia coli (STEC) and other pathogenic bacteria in seeds and sprouted seeds.** EFSA Journal 2011, 9 (11) (2011), p. 101



The aim of the study

To determine the influence of ionized water on germination, seedling growth rate and safety of sprouts of common (bread) wheat (*Triticum aestivum*) seeds.





Materials



Organic wheat seeds, soaked in:



Ionized alkaline water
pH 9

Ionized acidic water
pH 3.8

Ionized silvered
pH 9

Bidistilled water
(control)

Tap water (control)

H₂O₂ 8%



Experiment scheme + Methods

Preparation
of water
samples



Sprouting
seeds



Germination
(3 d, +20/+22)
Seedling growth rate
(7 d +20/ +22)
Total bacterial count
(LST EN ISO 4833:
2003)
Coliforms (LST EN ISO
4831: 1999)



Germination

- The term **germination** is often used loosely and sometimes incorrectly, being confounded with seedling growth, which begins when germination finishes.
- The global germination process include: the imbibition, the activation process, and intra-seminal growth that is completed with embryo protrusion.
- The visible radical represents the morphological marker of a germination test (with the score criterion **yes** or **no**).



Germination test



The test was made on an individual seed within a sample (100 seeds).

Mean for final cumulative germination percentage was calculated from 4 analogous tests.

Total Cumulative Germination percentage was calculated using the following formula given by Manmathan and Lapitan (2013).

Germination Percentage = (Seeds germinated / Total seeds) × 100



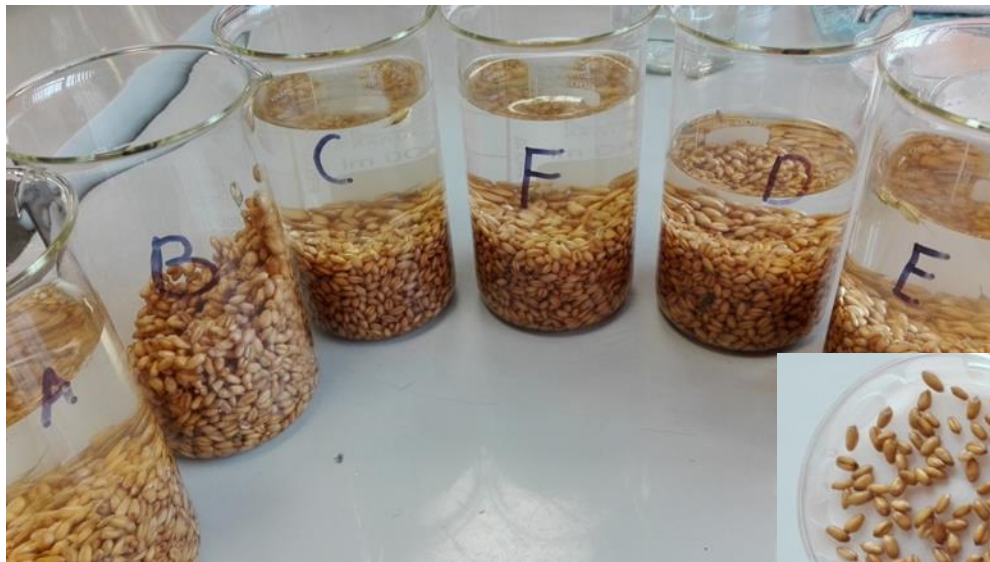
Seedling growth rate test



- Starting from the Day 3 after placement for germination seedlings were kept in Petri dish and allowed to grow up to 7 days by adding a required amount of respective solution daily.
- On the 7th day after placement for germination, 10 seedlings from each Petri dish were randomly sampled.
- Shoot length of individual seedling were recorded manually with a scale.



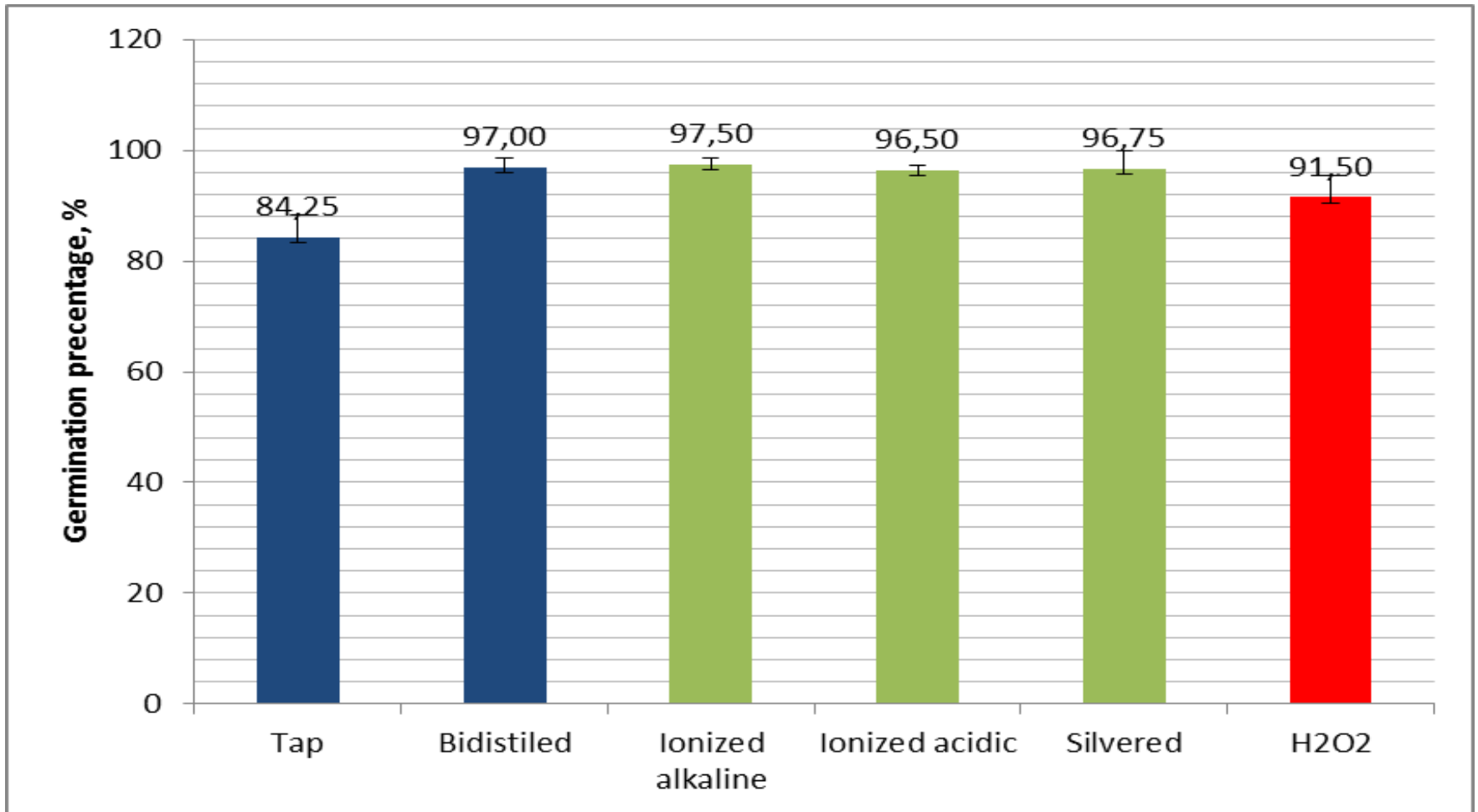
Results



S A L U S P R O P A T R I A



Final cumulative germination percentage





Effect of ionized water on germination (Day 3)

Ionized alkaline water

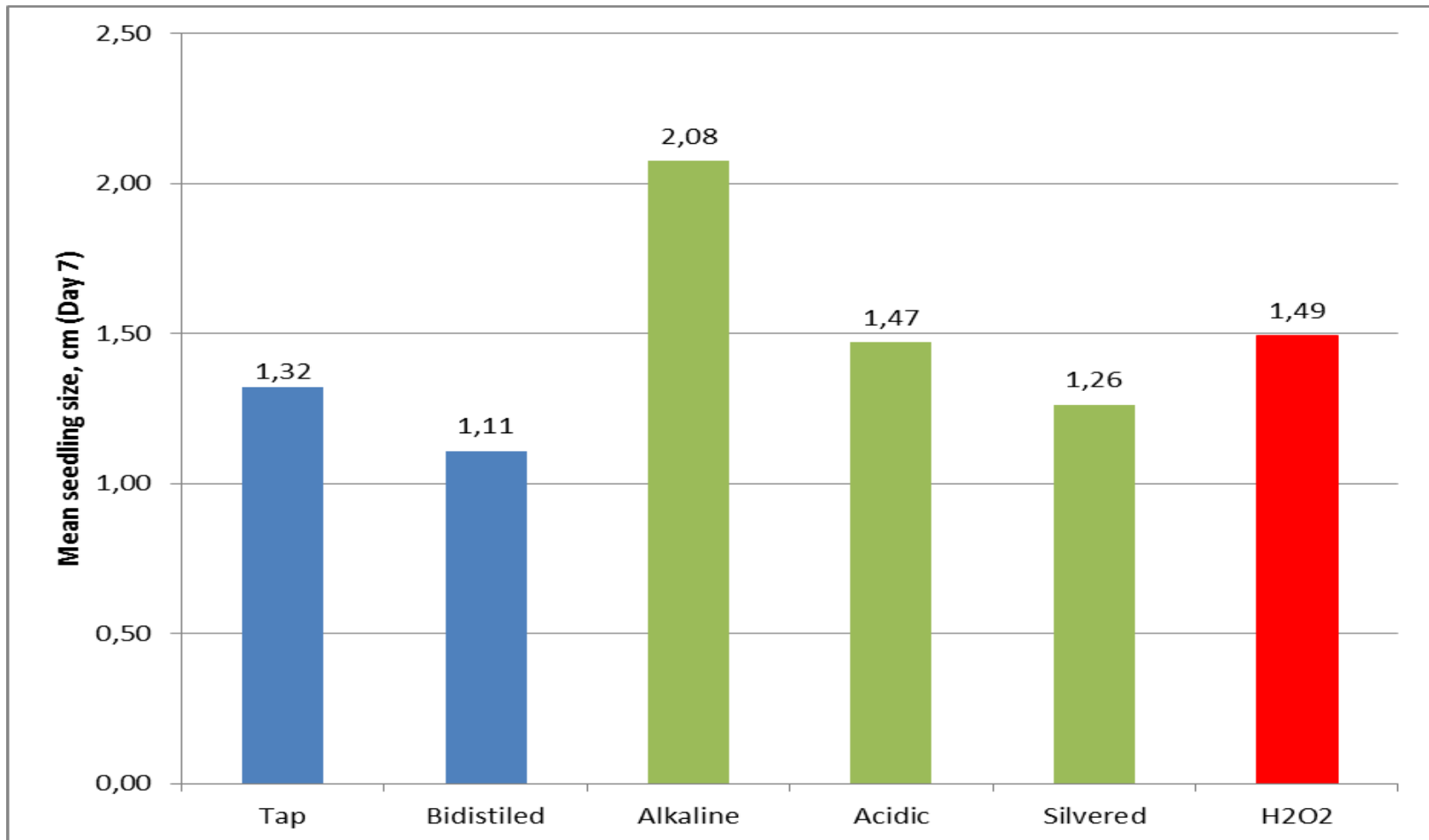


Tap water





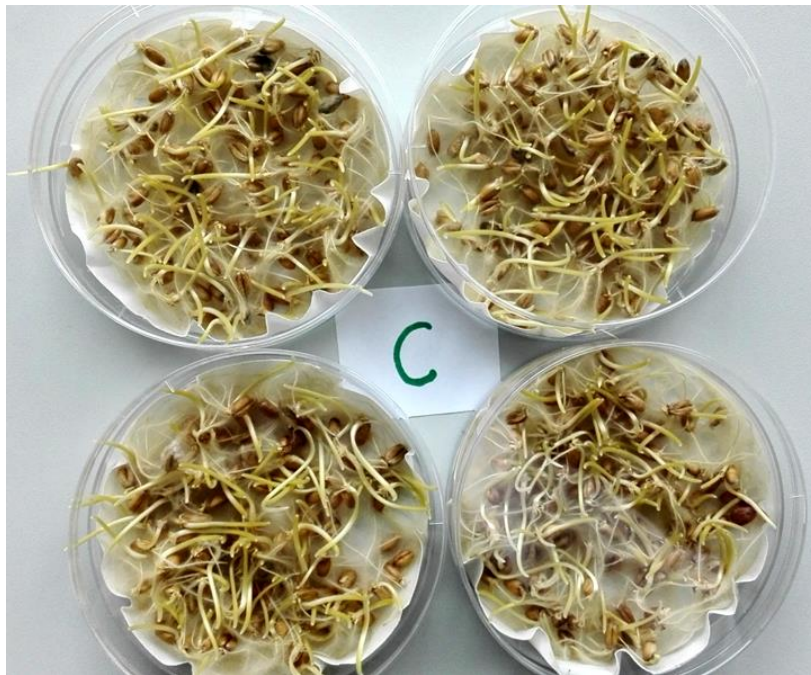
Seedling growth rate



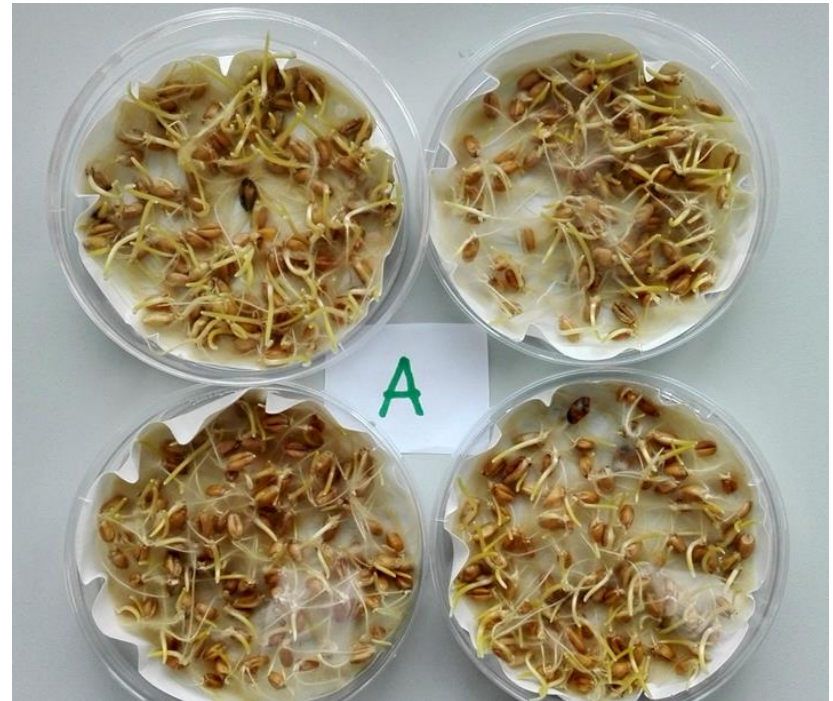


Effect of ionized water on seedling growth (Day 7)

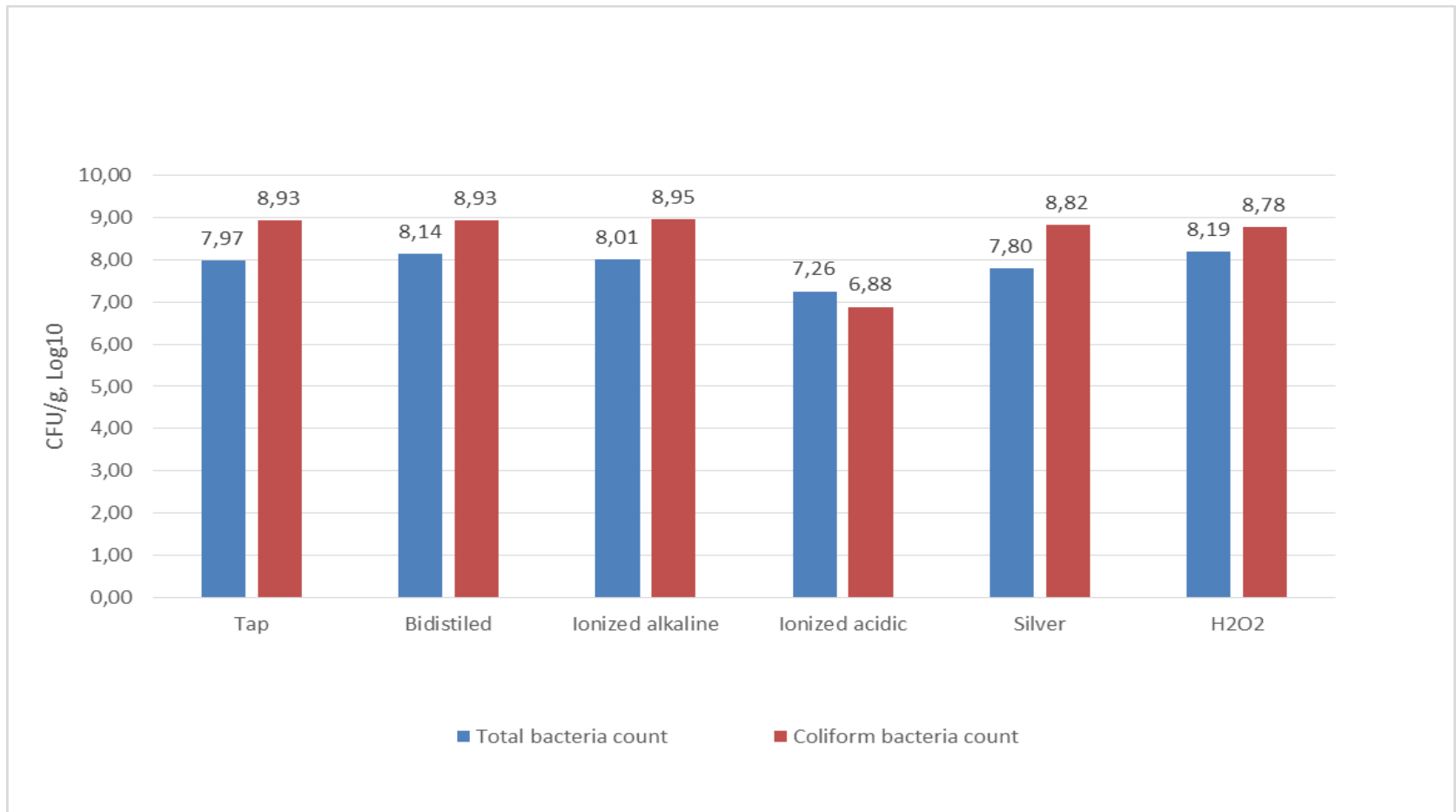
Ionized alkaline water



Tap water



Effect of water on microbial contamination of seeds



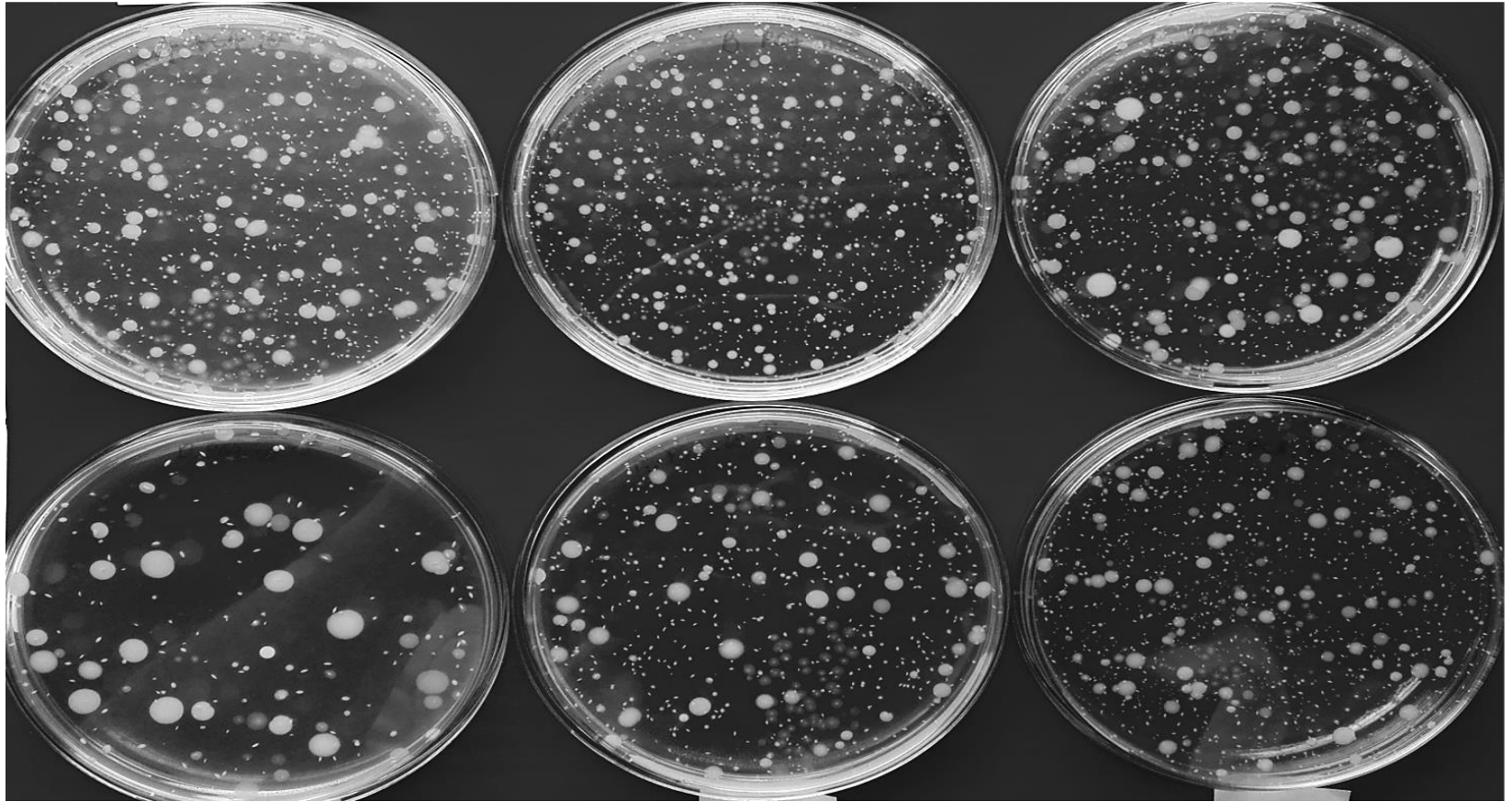


Total Bacteria Count Plates:

A-tap water (control)

B-distilled water (control)

C-alkaline



D-acidic

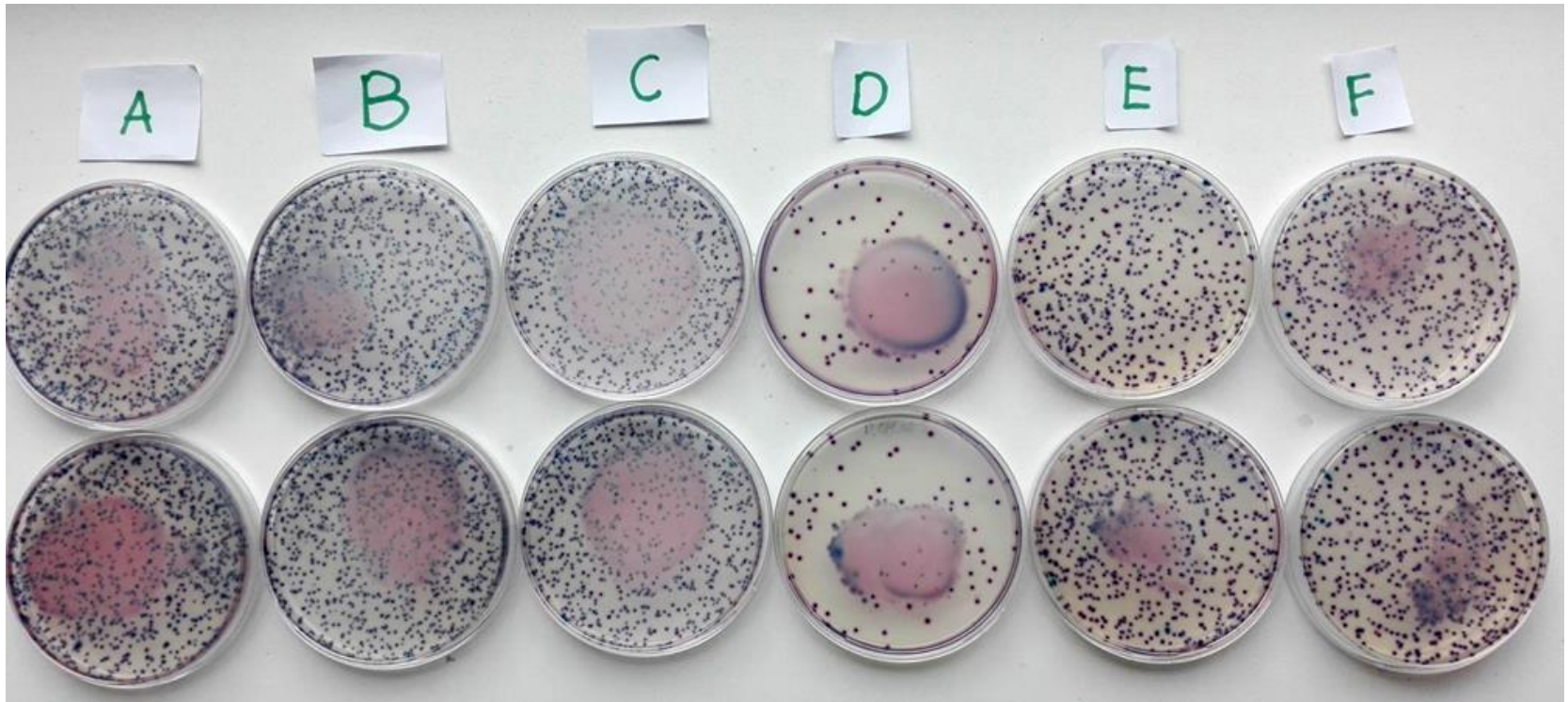
E-silvered

F-8% H₂O₂



Coliform Count Plates:

**A-tap water (control), B-distilled water (control),
C-alkaline, D-acidic, E-silvered, F-8% concentration of
hydrogen peroxide (currently approved disinfectant)**





Conclusions

- Ionized **alkaline water** can be beneficial for germination, growth and irrigation of seeds.
- Ionized **acidic water** can play a role of an effective and safe disinfectant in sprouts production.



Thank you for your attention!



2018-06-12

S A L U S P R O P A T R I A