Scientific Papers. Series A. Agronomy, Vol. LXIV, No. 1, 2021
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

A NEW METHOD FOR PREPARATION OF PESTICIDAL SOAPS VIA MACERATION OF ORGANIC SCRAPS

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Abstract

Exctraction is a method for separation of biologically active substances from plant's (and animal's) cells by using of different solvents. The oldest variation of this method is a preparation of tea and coffee drinks via hot water. Exactly water was the oldest and the most common used solvent especially in the area of food preparation and folk medicine. In the present day inductriual extractions can be achieved by various technologies include maceration, infusion, percolation, digestion, decoction, hot continuous extraction (Soxhlet) and so on. The soap is one of the oldest chemical products in the human mankind dates back from the times of ancient Babylon. The soap has enormous influence on human society as major biocidal product against harmful microorganisms but also as one of the oldest pesticide in the world. During the resent years, there is a renew interest for the soaps as a natural friendly pesticides. Traditionally soaps are made by mixing organic acids (from petroleum, animal or plant origin) with sodium or potassium hydroxide, with or without heating. The study in this paper shows that there is yet another effective and cheap method for this, by maceration of different organic scraps with low concentrated water solutions of potassium or sodium hydroxide. The soaps produced by this method show excellent aphicidal activity against different aphid species.

Key words*: soap, maceration, aphids, pesticide.*

INTRODUCTION

Extraction is a method for separation of biologically active substances from plant's (and animal's) cells by using of different solvents (Gupta et al., 2012). The oldest variation of this method is a preparation of tea and coffee drinks via hot water. Exactly water was the oldest and the most common used solvent especially in the area of food preparation and folk medicine (Altemimi et al., 2017). In the present day inductriual extractions can be achieved by various technologies include maceration, infusion, percolation, digestion, decoction, hot continuous extraction (Soxhlet) and so on (Azmir et al., 2013). In this paper a new method for preparation of pesticidal soaps via maceration of organic scraps is described. The soap has enormous influence on human society as major biocidal product against harmful microorganisms but also as one of the oldest pesticide in the world (Weinzierl, 2000). During the resent years, there is a renew interest for the soaps as a natural friendly pesticides. Traditionally soaps are made by mixing organic acids (from petroleum, animal or plant origin) with sodium or potassium hydroxide, with or without heating. There are two major drawbacks in this methods: the requirement for heating from one side and the using of highly concentrated solutions of potassium hydroxide from the other. Plus the facts that for this manufacture a pure oils or fatty acids are also required. Organic scraps are pretty big problem in nowadays however. There are a lot of wastes from many industrial, agricultural and plublic manufactures and services. In the most cases this scraps are used for animal feed, heating sources or organic manures (Odlare et al., 2015). However such wastes can be full with harmful micro and macro organisms which even the heat generated from the composting process can not kill. From the other side during recent years the pesticidal soaps became more and more popular especially in the area of organic agriculture and integrated pest management (Curkovic, 2016). The crisis with COVID-19 additionally boosts enormously the needs and uses of disinfectants (Rubio-Romero et al., 2020)

MATERIALS AND METHODS

Different organic scraps as olives and apricot pits, dry fallen tree leaves, wheat straw and

seeds husks, tobacco wastes from cigars manufacture ("furda") were used.
The scraps were soaked in distilled water solution of potassium hydroxide at different concentrations for different amount of time. After that the solutions were filtered and were used for preparation of 1 % (v/v) water solutions also with distilled water. Via standard tensionmeter Kruss Force Tensiometer – K6 (Ali et al., 2019) was measured the surface tensions of this 1 % (v/v) water solutions for determination of the best variant for making soaps via this method i.e. – determination of the most appropriate concentration of potassium hydroxide and time for maceration.
The standard in vivo trials insecticidal activity towards different aphid species (*Aphis pomi*, *Aphis roase, Aphis gossypii* and *Aphis nerri*) were conducted (Ganchev & Atanasova, 2015). The percent effectiveness was calculated via formulae of Abbot (Fleming & Retnakaran, 1985). The phytoxocity in vivo test for establishing the eventual harmful action various towards cultural and non-cultural crops ware also performed (Ganchev et. al, 2012).

RESULTS AND DISCUSSIONS

The results show that all used organic wastes can be sources for soaps. However the amount of potassium hydroxide solution needed for saponification of the different organic scraps is different. The indicator in this case was to be produced as concentrated as possible solutions i.e. – the amount of potassium hydroxide solution to be as minimal as possible but the thinness of the received liquid soaps to allow filtration. If the amount of potassium hydroxide solution is too low, the filtration was completely impossible.
The Figure 1 show the concentration of the used organic scraps in the hydroxide solution in the maceration process i.e saponification
The results clearly show how small is the ratio between organic scraps and potassium hydrate solution. Even in the case of dry fallen tree leaves it is 2.5 %. The pits (olive and apricot) have the highest percent but this is due the highest density and presence of lignocellulosic materials
The results show also that the 1 % (v/v) water solutions from the liquid soaps produced by this method from different organic scraps can have different surface tension. And even more, the lowest possible surface tension can be achieved at different concentration of potassium hydroxide for the different type of wastes.

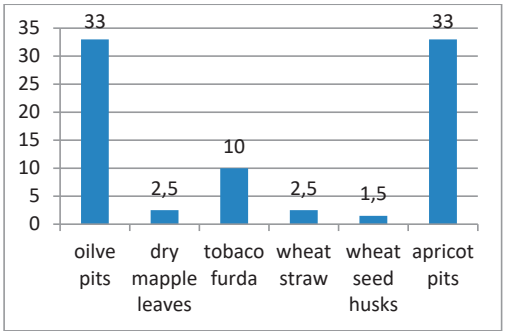

Figure 1. Percent concentration of organic scraps in KOH solution

However if the concentration of solution is too low (0.1 - 0.5 % (m/v)) this can be also not appropriate for making soaps by this way, due to the spoiling of solutions. The maceration period by this way was almost the same for all soaps approximately 20-21 days for optimal results, minimum 24-48 hours period for saponification. On the graphics bellow (Figures 2-7) is shown the surface tension of 1 % water solutions of created soaps:

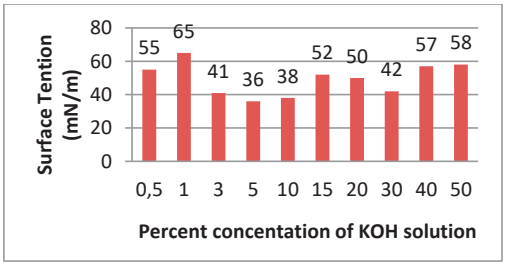

Figure 2. Surface tension (mN/m) of soaps made by maceration of olive pits

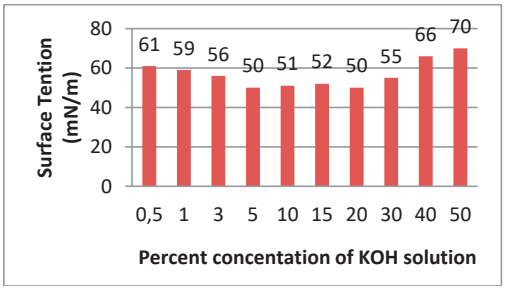

Figure 3. Surface tension (mN/m) of soaps made by maceration of dry mapple leaves

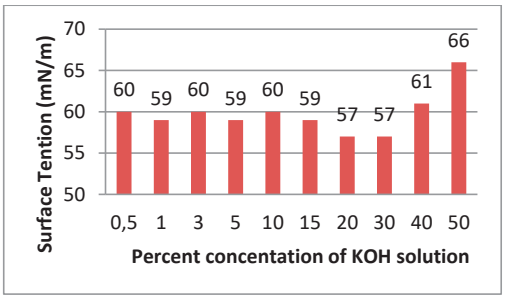

Figure 4. Surface tension (mN/m) of soaps made by maceration of tobaco furda

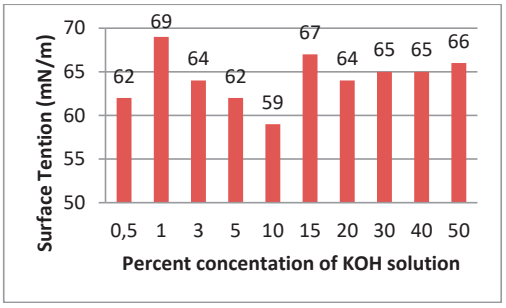

Figure 5. Surface tension (mN/m) of soaps made by maceration of wheat straw

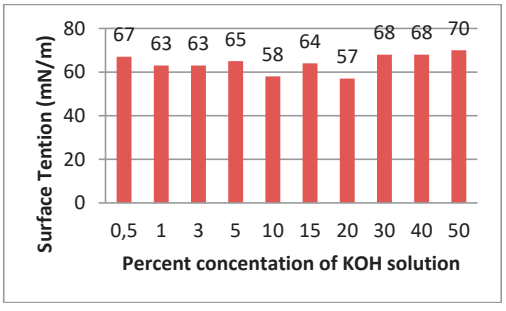

Figure 6. Surface tension (mN/m) of soaps made by maceration of wheat husks

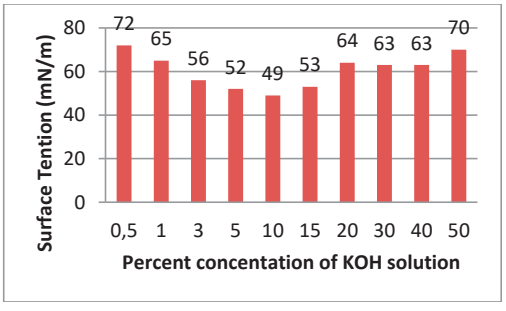

Figure7. Surface tension (mN/m) of soaps made by maceration of apricoat pits

The results show that for the different organic scraps, the concentration of potassium hydroxide of solution which can produce soaps with highest ability to low the surface tension is between 5 and 10 %. Exception is for the tobacco furda (tobacco organic scraps from manufacture of cigars). Soaps made by wastes from fruda, wheat straw, husks and tree dry leaves had lower ability for decreasing of surface tension but this is due to the lowest lipids content from the one hand (compared with the same of pits, especially oilves) and lowest concentrations of the scraps into potassium hydroxide solutions from the other.

In the Figure 8 is shown the surface tension of 1 % water solutions (prepared with distilled water) of popular trade mark various cleaning products in Bulgaria plus one of the most popular surfactant for agricultural plant protection products – Silwet L77. The measurements were made at 25°C:

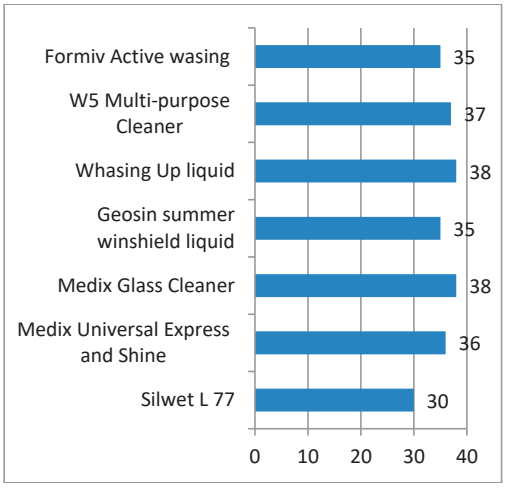

Figure 8. Surface tension (mN/m) of cleaning products

As can be see, the 1 % water solution of soap made by maceration from olive pits (33 % solution at 5 % KOH) can achieve the same (and even better) lowering of the surface tension compared with commercial cleaning products. The conducted test reveal that the same olive pits can be reuse for this yet 2 times. The same is valid for apricot pits. However the other tested organic scraps like dry leaves, furda, straw and husks were almost or at high degree disassembled during the maceration (saponify-cation) process to be reused again.

The conducted trials for insecticidal activity reveal the strong insecticidal action of all tested

soaps towards different aphid species. On the graphics below (Figures 9-11) are listed some of the Dose – Responses Curves (Models):

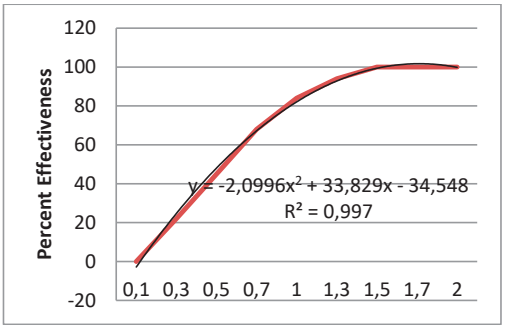

Figure 9. Olive Pits Soap, Aphis pomi: Dose - Response Curve

- LD05= 0.34 % (v/v)
- LD25=0.46 % (v/v)
- LD50=0.6 % (v/v)
- LD90=0.78 % (v/v)

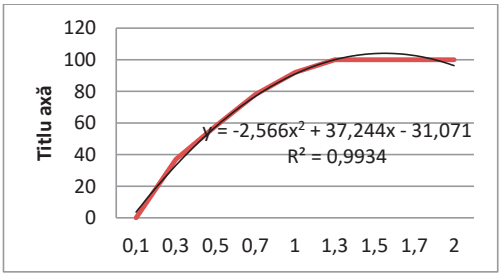

Figure 10. Apricot Pits Soap, Aphis rosae : Dose - Response Curve

- LD05=0.104 % (v/v)
- LD25=0.25 % (v/v)
- LD50=0.66 % (v/v)
- LD90=0.91 % (v/v)

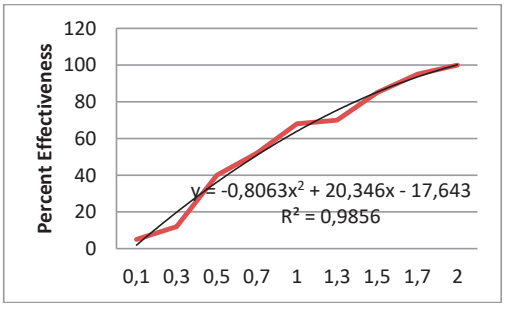

Figure 11. Dry Maple Leaves, Aphis pomi Dose - Response Curve

- LD05=0.16 % (v/v)
- LD25=0.34 % (v/v)
- LD50=0.94 % (v/v)
- LD90=1.55 % (v/v)

The soaps on the base of pits (olive and apricot) were able to kill aphids at 0.7-0.8-0.9 % concentrations, while the rest of the soaps – at 1.5-1.7-1.8 % concentrations - the difference is due to the lower percent of organic wastes in potassium hydroxide solution. There were no statistically significant differences ($p>0.05$) in the effectiveness of the given soap type towards different aphid species.

However there is the phytotoxicity of the soaps in some cases towards different plants. The trials show that plants like oil – yielding roses, wheat, apples, cherries and sour cherries and walnut are pretty resistant to the action of soaps and react with no or minimal phytotoxic symptoms (necrosis, chlorosis, deformations, whitening), with chemotherapeutic coefficient = 3.5-4. Other plants like cucumber, pumpkin, water melons, peach, potatoes, peppers can be sensitive and soaps can cause significant damages on them, with chemotherapeutic coefficient = 0.2-0.5

CONCUSIONS AND DICUSSIONS

The conducted trials reveal that maceration of organic scraps in potassium hydroxide solution can be viable method for production of soaps and utilization of such kind wastes. Even garbage organic materials like dry fallen tree leaves can be used for production of soaps. The produced soaps from one hand can be used as a standard disinfectants and for naturally friendly plant protection product – from the other. The soaps of course can undergo additional chemical procedures as pH correction, addition of other active organic or non organic substances fragrances addition and other. In this process concentration of potassium hydroxide is much more lower than in the standard soap manufacture, plus the fact that percent ratio between organic wastes and potassium hydroxide solution is also low.

REFERENCES

Ali, S., Badshah, A., Hussain, H., Fatima, S., Shah, A.H., Shah, Shah, M.R. (2019). Synthesis, Characterization, and Computational Study of New Ferrocene-Based Schiff Bases as Potential Nonionic Surfactants. *Journal of Surfactants and Detergents, 22*(4), 897–906.

Altemimi, A., Lakhssassi, N., Baharlouei, A., Watson, D. G., Lightfoot, D.A. (2017). Phytochemicals: Extraction, isolation, and identification of bioactive compounds from plant extracts. *Plants,* 6(4), 42.

Azmir, J., Zaidul, I.S.M., Rahman, M.M., Sharif, K.M., Mohamed, A., Sahena, F., ... & Omar, A.K.M. (2013). Techniques for extraction of bioactive compounds from plant materials: A review. *Journal of food engineering, 117*(4), 426–436.

Curkovic, T. (2016). Detergents and soaps as tools for IPM in agriculture. Integrated pest management (IPM): Environmentally sound pest management.

Fleming, R., Retnakaran, A. (1985). Evaluating single treatment data using Abbott's formula with reference to insecticides. *Journal of Economic Entomology, 78*(6), 1179–1181.

Ganchev, D.H., Marinov, M.N., Marinova, P.E., Krustev, S.V., Zlateva, M.R., Atanasova, N.I., Stoyanov, N.M. (2012). In vivo phytotoxicological study of cyclopentanespiro-5-hydantoin and its derivatives towards some cultural and non-cultural plants. Association Scientific and Applied Research.

Ganchev, D., Atanasova, D. (2015). In vitro screening for insecticidal activity of natural pesticides based on plant soaps against *Aphis nerii* Boyer de Fonscolombe and *Macrosiphum rosae* (L.) (Hemiptera: Aphididae). Agricultural Sciences/Agrarni Nauki, 7(18).

Gupta, A., Naraniwal, M., Kothari, V. (2012). Modern extraction methods for preparation of bioactive plant extracts. International journal of applied and natural sciences, *1*(1), 8–26.

Odlare, M., Lindmark, J., Ericsson, A., Pell, M. (2015). Use of organic wastes in agriculture. *Energy Procedia, 75*. 2472—2476.

Rubio-Romero, J.C., del Carmen Pardo-Ferreira, M., García, J.A.T., Calero-Castro, S. (2020). Disposable masks: Disinfection and sterilization for reuse, and non-certified manufacturing, in the face of shortages during the COVID-19 pandemic. *Safety Science*, 104830.

Weinzierl, R.A. (2000). Botanical insecticides, soaps, and oils. Biological and biotechnological control of insect pests, 101–21.