EVALUATION OF THE ANTIMICROBIAL ACTIVITY OF $AgNO_3$ ON BRAN EXTRACT

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Abstract
Upon intense study of recently published literature, I have noticed that research on silver nanoparticles is a field of major interest, due to their wide range of applications. They have antioxidant and antimicrobial properties, small dimensions, are thermally and chemically stable and have low-level toxicity.
The synthesized nanoparticles show high stability in aqueous suspension even several months after storage, indicating that no aggregation of nanoparticles has occurred.
Investigations using these methods have demonstrated strong antimicrobial activity of these nanomaterials.
The microbiological study on the analyzed brans (wheat, spelt wheat, barley, rye and oats) treated with silver nanoparticles was conducted in order to reduce the total microbiota, being known that the brans have a high microbial load. The highest reduction in microbial load occurred for rye bran, a lower total number of microorganisms being recorded, smaller by 7.29 logarithmic units / g bran after treating them with silver nanoparticles.

***Key words**: bran, wheat, oats, barley, rye, silver nanoparticles*

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1. INTRODUCTION

Nanomaterials have unique properties due to their nanometric structure. These unique properties are due to the one-dimensional structure they form. Nanomaterials are obtained through nanotechnology. Richard Feynman, the physicist who won the Nobel Prize in 1965, founded of this concept (Pacioni s.a, 2015).

Cereals consist of three parts: bran, endosperm and germ.

Bran grains are the outer layer of cereal grains, abounding in various nutrients and fiber. During the grinding process, the bran is removed from the core and becomes a by-product. The bran has a special flavor and can be added to the manufacture of bakery products in order to increase the amount of nutrients, fiber, helps to improve the texture and taste of these products (Biel s.a, 2009).

The study was conducted in order to obtain food based on bran, through microbiological stabilization with $AgNO_3$ nanoparticles.

Another direction of research was to subject the bran to $AgNO_3$ nanoparticles treatment, for their use in larger quantities in bakery products in order to increase the minimum durability and the intake of vitamins, minerals, fiber in dietary bakery products.

2. METHODS AND MATERIALS

2.1.Materials

Wheat brans Most important part of the wheat bran lies within its outer coating, found integrally in bran (representing 14% of the wheat bran). Wheat bran contains fibers and large quantity of B vitamins and mineral substances with a multitude of nutritional health benefits (Webster s.a, 1986).

Spelt wheat brans contain minerals such as Fe, Mg, Ca, P, Se and A, B1, B2, E vitamins, niacin (PP vitamin). The amount of selenium in the composition is 7-8 times larger compared to other types of cereal.

Rye brans contain high levels of vitamins and minerals.

Barley brans contain calcium (33 mg), iron (3,6 mg), magnesium (133 mg), phosphorus (264 mg), potassium (452 mg), sodium (12 mg), zinc (2,77 mg), copper (0,4498 mg), selenium (37,7 µg) and high levels of vitamins (Oscarsson s.a, 1996).

Oat brans

The oat bran is derived from the outermost of the oat grain and contains protein, iron, calcium, phosphorus, magnesium, zinc but low calory. Oat brans may be used in bakery products and in many types of sweet or savory dough (homemade bread, cakes, pies, muffins, salads, biscuits). They provide high intake of dietary fiber and minerals in the food that contains them (Welch, 1995).

2.2.Methods

TGN determination in wheat bran, spelt wheat, oat, barley, rye

Brans from various sources (wheat, spelt wheat, oats, barley, rye) were used in the experimental study. For microbiological analysis, decimal dilutions were conducted, using sterile peptone water as diluent.

The initial brans suspended in sterile water (1/100 ratio) were stirred for 15 minutes and left rest for 1 hour. Subsequently, each suspension was diluted in decimal system and then seeded in agar meat broth culture media. After uniformity of the distribution of microorganisms in the culture media and rest for solidification, the Petri dishes were heat-stabilized at 37°C for 48 hours. Then, the colonies formed on BCA in the Petri dishes were counted and, after applying the dilution coefficient, the initial load of the analyzed bran was determined.

Total microbiota determination in bran treated with silver nanoparticles

For treatment with silver nanoparticles, the initial suspensions of brans in water were filtered through a sterile filter. The filtrates were treated with $AgNO_3$ nanoparticles and one hour after resting, decimal dilutions in peptone water and inoculation in meat broth with agar were conducted. The Petri dishes with inoculated culture media were heat-stabilized at 37°C for 48 hours.

3. RESULTS AND DISCUSSIONS

Five types of brans from flour in the milling industry were studied from a microbiological standpoint, in this paper. The results obtained are shown in Table 1.

Tabelul 1

Aerobic mesophilic microbiota of the analyzed brans

The analyzed sample	Number of microorganisms expressed in ufc/g
Wheat bran	$3,9x10^7$
Spelt wheat bran	$3,7x10^6$
Rye bran	$1,9x10^{11}$
Barley bran	$1,6x10^{11}$
Oat bran	$3,4x10^6$

As a result of the experiment aimed to determine the total number (TNG) / g of germs in the analyzed bran samples, it was observed that the microbial load varies between 6.53 and 11.29 log cfu / g. (Fig.1). The highest value was recorded for rye bran, 1.72 times higher than for oat bran.

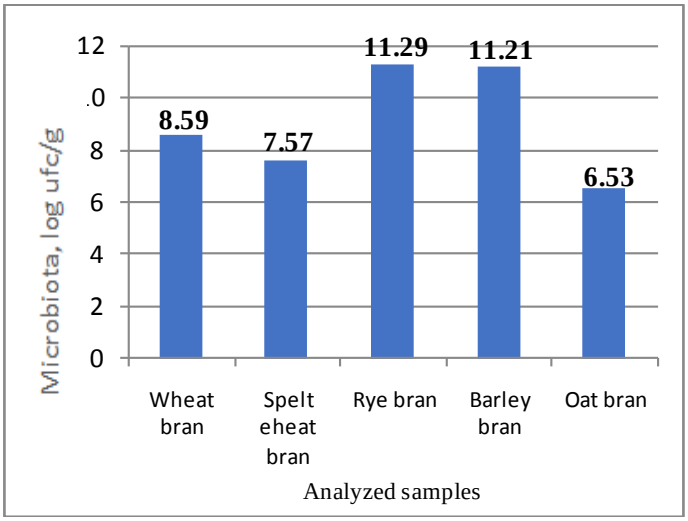


Fig.1. Aerobic mesophilic microbiota of the analyzed bran types

Barley bran had a microbial load close to that of rye bran, being 0.08 logarithmic units lower. Oat bran has the lowest microbial load, being about 5 logarithmic units lower than rye bran and barley bran, with 2 logarithmic units lower than wheat bran and with a lower logarithmic unit compared to spelt wheat bran.

Following the microbiological study of the bran samples treated with $AgNO_3$, it was observed that the microbial load varies between 3.60 and 4.48 log cfu / g (Fig. 2). The highest microbial load was recorded in the barley bran sample, with 4.48 log cfu / g. As for the oat bran and wheat bran, spelt recorded the same microbial load, respectively 3.60 logarithmic units. Wheat bran had a microbial load close to spelt wheat bran and oat bran, 0.18 logarithmic units higher.

The images below show Petri dishes with meat broth with agar from bran suspensions before and after treating them with silver nanoparticles.

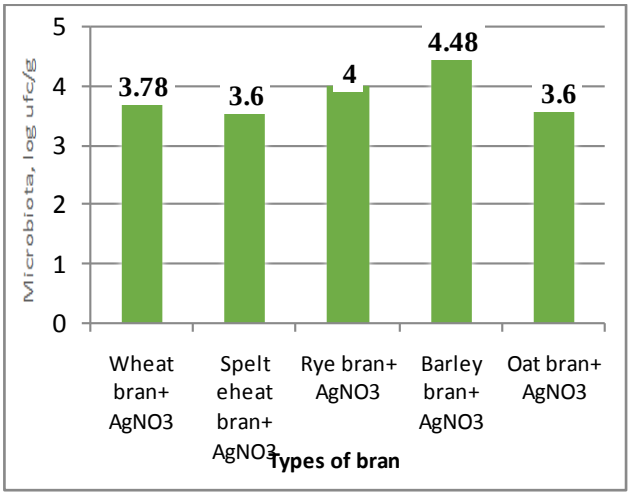
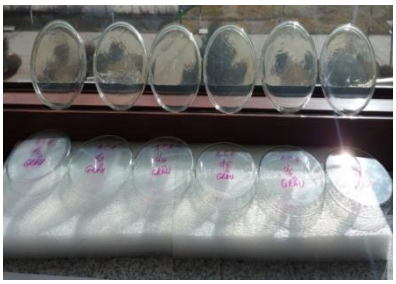
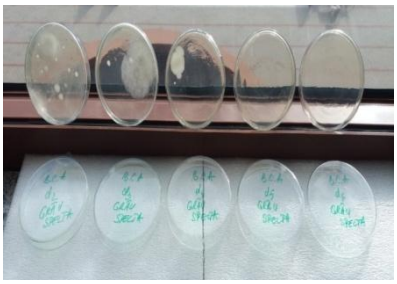


Fig. 2 Aerobic mesophilic microbiota of bran after treatment with $AgNO_3$

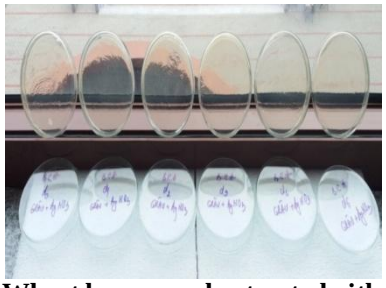


Wheat bran samples

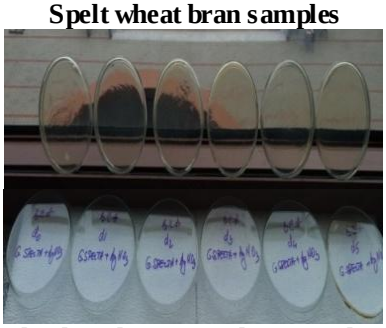


Spelt wheat bran samples

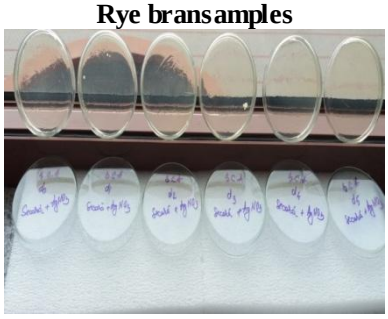
Rye bransamples



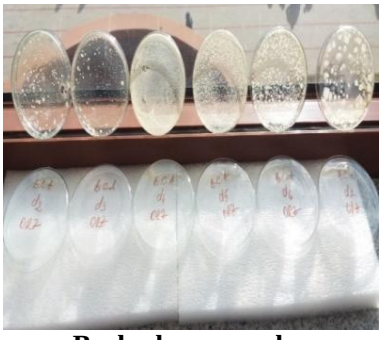
Wheat bran samples treated with $AgNO_3$



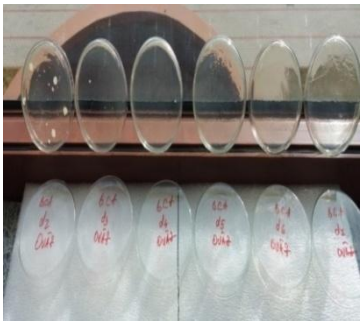
Spelt wheat bran samplestreated with $AgNO_3$



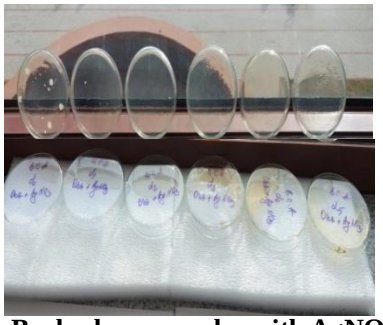
Rye bransamplestreated with $AgNO_3$



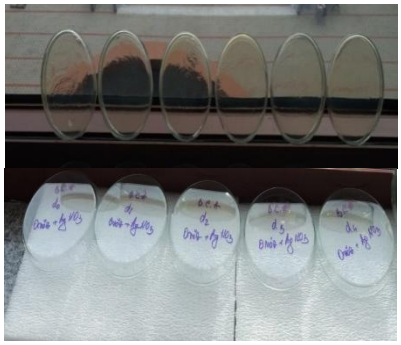
Barley bran samples



Oat bran samples



Barley bran samples with $AgNO_3$



Oat bran samples treated with $AgNO_3$

Following the silver nanoparticles treatment, it was observed that the total number of microorganisms reported per gram of brans analyzed was reduced for all samples analyzed and framed between 3.4-4.48 log cfu / g. Thus, it was observed that the highest reduction in microbial load occurred for rye bran, a lower total number of microorganisms being recoreded, smaller by 7.29 logarithmic units / g bran after treating them with silver nanoparticles. Also, the reduction in the number of microorganisms / g bran was by 2.5 times in barley bran treated with silver nanoparticles.

The antimicrobial effect of $AgNO_3$ on the analyzed bran, under the given experimental conditions, was best observed in barley and rye bran samples, which have the highest microbial load prior treatment with silver nanoparticles.

4. CONCLUSIONS

The microbiological study on the analyzed brans (wheat, spelt wheat, barley, rye and oats) treated with silver nanoparticles was conducted in order to reduce the total microbiota, being known that the brans have a high microbial load.

The strongest antimicrobial effect was highlighted in barley and rye brans, which stood out due to their higher initial microbial load compared to the other analyzed samples. Treatment with silver nanoparticles led to a significant decrease in the number of microorganisms under given experimental conditions.

5. BIBLIOGRAPHY

[1] Pacioni, N. L., C. D. Borsarelli, V. Rey şi A. V. Veglia, Synthetic Routes for the Preparation of Sliver Nanoparticles, 2015, în Silver Nanoparticle Applications in the fabrication and Design of Medical and Biosensing Devices, Alarcon, E; Griffith, M.; Udekwu, K. I. (Eds.),

[2] Prema P, Thangapandiyan S. CMC stabilized nano silver synthesis, characterization and its antibacterial and synergistic effect with broad spectrum antibiotics. Carbohydrate Polymers. 2017; 158: 141-148.

[3] Biel, W., Bobko, K., Maciorowski, R., 2009. Chemical composition and nutritive value of husked and naked oats grain. Journal of cereal science 49, 413-418.

[4] Webster, F. H., 1986. Oats, in "Chemistry and Technology", USA, American Association of Cereal Chemists, pp. 220.

[5] Welch, R. W., 1995. The Oat Crop: Production and Utilization, London, Chapman & Hall, pp.516.

[6] Oscarsson M., Anderson R., Salomonsson A.C., Aman, P. Chemical composition of barley samples focusing on dietary fibre components. Journal of Cereal Science. 1996.

[7] Endosperm structure affects the malting quality of barley (Hordeum vulgare L.). Journal of Agricultural and Food Chemistry 53, 7279-7287.